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LIBRARY-CARD ABSTRACT

A model to predict intraurban travel demand by mode is developed from the substantial travel data base available in the San Francisco Bay Area. Characterizations of travel modes in terms of commuters attitudes is developed from a survey taken in the area as a part of this Contract. Ridge Trace Regression technique is utilized in developing this abstract model. Demand for a STOL commuter service is predicted for the area. An economic analysis shows a substantial profit is possible. (Extension to CR114347)

KEY WORDS

STOL - VTOL

Intraurban

Demand Model

Mode-split

Ridge Trace Regression

Preference Rating

Transportation

NASA CR-114418

STUDY OF AN INTRAURBAN TRAVEL DEMAND MODEL INCORPORATING COMMUTER PREFERENCE VARIABLES

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1.0 SUMMARY

This report presents the details of a study of an intraurban travel demand and modal split model incorporating commuter preference variables. This study is an extension to Contract NA2-5969, a study entitled "Study of Aircraft in Intraurban Transportation Systems - San Francisco Bay Area". This previous study showed the need for methods which would reduce the uncertainties of prediction of intraurban travel demand.

The model presented here is based on the substantial travel data base for the nine-county San Francisco Bay Area, provided by the Metropolitan Transportation Commission. The model is of the abstract type, and makes use of commuter attitudes towards modes and simple demographic characteristics of zones in a region to predict interzonal travel by mode for the region.

The demand models were initially developed using a step-wise least squares regression technique. However, collinearity among many of the variables produced unacceptable results and made it necessary to employ the Ridge Trace Regression technique.

Characterizations of travel modes in terms of commuters attitudes toward travel modes were developed from a survey taken in the San Francisco Bay Area as a part of this Contract. A characterization of the STOL/VTOL mode was extrapolated by means of a subjective comparison of its expected characteristics with those of modes characterized by the survey. A model for predicting overall trip satisfaction as a function of preference ratings for trip/vehicle characteristics was developed. A simple technique for estimating traffic diversion from existing modes to a newly introduced mode that is based on the concept of commuter willingness to pay a penalty time or penalty cost was constructed. A method for the inclusion of preference variables in a demand mode-split model was devised and such variables are included in the final model of this study.

Using the final model, predictions of STOL demand were made for the Bay Area and an aircraft network was developed to serve this demand. When this aircraft system is compared to the base case system of the previous study, the demand for STOL service has increased five fold and the resulting economics show considerable benefit from the increased scale of operations. In the previous study all systems required subsidy in varying amounts. The new system shows a substantial profit at an average fare of \$3.55 per trip and justifies further work in the area of aircraft commuter transportation.

2.0 INTRODUCTION

In June 1971, The Boeing Company completed a study for NASA (Contract NAS2-5969) entitled "Study of Aircraft in Intraurban Transportation Systems - San Francisco Bay Area", Reference 1. This study determined the technical, economic, and operational characteristics of a commuter-oriented aircraft transportation system, using a detailed data base of travel characteristics in the area. One of the conclusions of the study was: The absolute level of air traffic predicted in this study is subject to question due to general uncertainties associated with prediction techniques for passenger acceptance of a new mode of travel.

Thus, an extension to that study was undertaken to provide methods which reduce the uncertainties of prediction of passenger travel. This objective was to be accomplished primarily through inclusion of traveler attitudinal variables in the prediction model. The study uses the data base of travel surveys in the San Francisco Bay Area to develop a generalized demand and modal split model so that studies of other major urban areas can be easily accomplished, without the necessity of costly travel surveys. Attitudes and simple demographic characteristics of zones in a region can be used to predict interzonal travel by mode for the region.

In order for transportation planners to make the decisions necessary to meet future requirements, a good forecast is required, not only of total transportation demand, but also of demand for each alternative mode. Thus, a knowledge is required of why people choose certain modes and what is necessary to influence this decision process. The existing knowledge of the basic decision process is simply inadequate.

The work reported on here is a first step towards an understanding of this decision process. The major emphasis here is on obtaining and interpreting traveler attitudes towards the modes of transportation actually used. Many other, and perhaps more important, questions have not been investigated, such as:

- Attitudes towards automobiles as something more than just transportation.
- Propensity to change modes as a function of the total transportation system.
- Impact of ecological considerations.
- Actual and perceived costs, particularly of automobile transportation.

The first step in this study was to construct an elementary demand model, using available Bay Area data, for comparison to the demand models used in the Northeast Corridor study (see Reference 2). The approach made use of the concept of congestion nodes and included explicit dependence on employed population, as well as total population. The results were encouraging, in that improved predictions of the Northeast Corridor data were obtained. However, no completely objective way to characterize congestion was found, and this approach was abandoned. The results are presented in Appendix A, by R.V. Panos.

A preference survey was developed and carried out in the Bay Area to obtain information on traveler attitudes. Attitude values for independent mode characteristics were captured by means of stanine (or standard nine) scales, a common psychometric technique. Dependence of travel on attitudes was investigated through regression modeling. The importance of attitudes was shown independently through discriminant analysis.

In order to extend the analysis to the use of aircraft in intraurban transportation systems, attitudes were extrapolated to cover the characteristics of STOL and VTOL vehicles. Resulting mode split implications were investigated. Work pertaining to the preference survey is covered in Section 4.0.

A generalized intraurban demand and modal split model was constructed, utilizing both demographic and attitudinal variables. Terms were included to account for both trip generation and trip attraction factors. The results are presented in Section 5.0.

A comparison was made with the San Francisco Intraurban Study, Reference 1, to measure the impact of the demand and modal split model on the characteristics of an aircraft intraurban transportation system. Redistribution of travel, modal split changes, and network model comparisons are given in Section 6.0.

Section 7.0 describes application of the model and gives the results obtained for Detroit.

3.0 CONCLUSIONS

The "Study of Aircraft in Intraurban Transportation Systems, San Francisco Bay Area", Reference 1, concluded: "The aircraft intraurban system is a technically feasible alternative to ground transportation systems." As a result of this extension to that study, we can add the following conclusions:

- The aircraft intraurban transportation system can also be economically feasible if the scale of operation is increased substantially. This now places overall feasibility more completely on the question of market credibility.

- At this much increased scale of operations, the total cost per passenger trip is reduced to $2.53 and investment costs are overshadowed by the operating costs of the aircraft.

- It is shown for the first time that variables representing preference ratings on trip/vehicle characteristics can be included in demand mode - split models. Only the surface has been scratched, however, and much more intensive study of these variables and their predictive capability is required.

- Both the survey data and the final mode-split model are consistent in their evidence that cost is not a principal predictor of traffic demand in intraurban areas.

- The absolute level of air traffic predicted by the demand and modal split model still remains subject to question as a result of the model's insensitivity to cost.

- The air transportation system could only exist if a complete system of feeder transportation systems is developed around each terminal, to minimize the inconvenience of changing modes.

4.0 BAY AREA PREFERENCE SURVEY

4.1 INTRODUCTION

A set of statistical techniques relying heavily on psychological preference rating scales has been developed by The Boeing Company. These techniques have made it possible to estimate average flight loads to within a few passengers, and market shares almost to the percentage point for several of the larger commercial airline markets. Even more importantly, inherent in these techniques is the process of quantification of differences between travel modes.

Surveys of travelers' ratings of trip and vehicle characteristics can be used to determine the relative importance of existing factors affecting travel mode preference, such as comfort, convenience, and service. An overall trip rating can be determined in terms of these factors and can also be measured in terms of a traveler's willingness to pay a penalty in terms of a schedule change or a cost premium in order to use a specific mode of travel.

Finally, given the results of such ratings, it is possible to predict how an alternate mode like an intraurban STOL would look in terms of the rating scales. The new mode can then be described in a mode split model and an estimate of demand for it can be obtained. Reference 3 is a summary report that covers the entire history of the rating scale approach to preference analysis as developed and applied by The Boeing Company.

4.2 THE TRIP RATING SURVEY FORM

To identify the causative factors affecting a traveler's feelings about his intraurban trips, a set of scales was developed for rating specific features of the trip. These features selected for inclusion in the survey fall into three primary categories:

I. Service factors

Enroute time
Waiting time
Trip cost
Parking cost
Service assistance
Personal safety and security
Privacy
Productive use of time

2. Convenience factors

   Schedule reliability
   Seat availability
   Adequacy of transfers
   Terminal access
   Terminal climate
   Terminal facilities
   Method of payment
   Route Alternatives

3. Vehicle characteristics

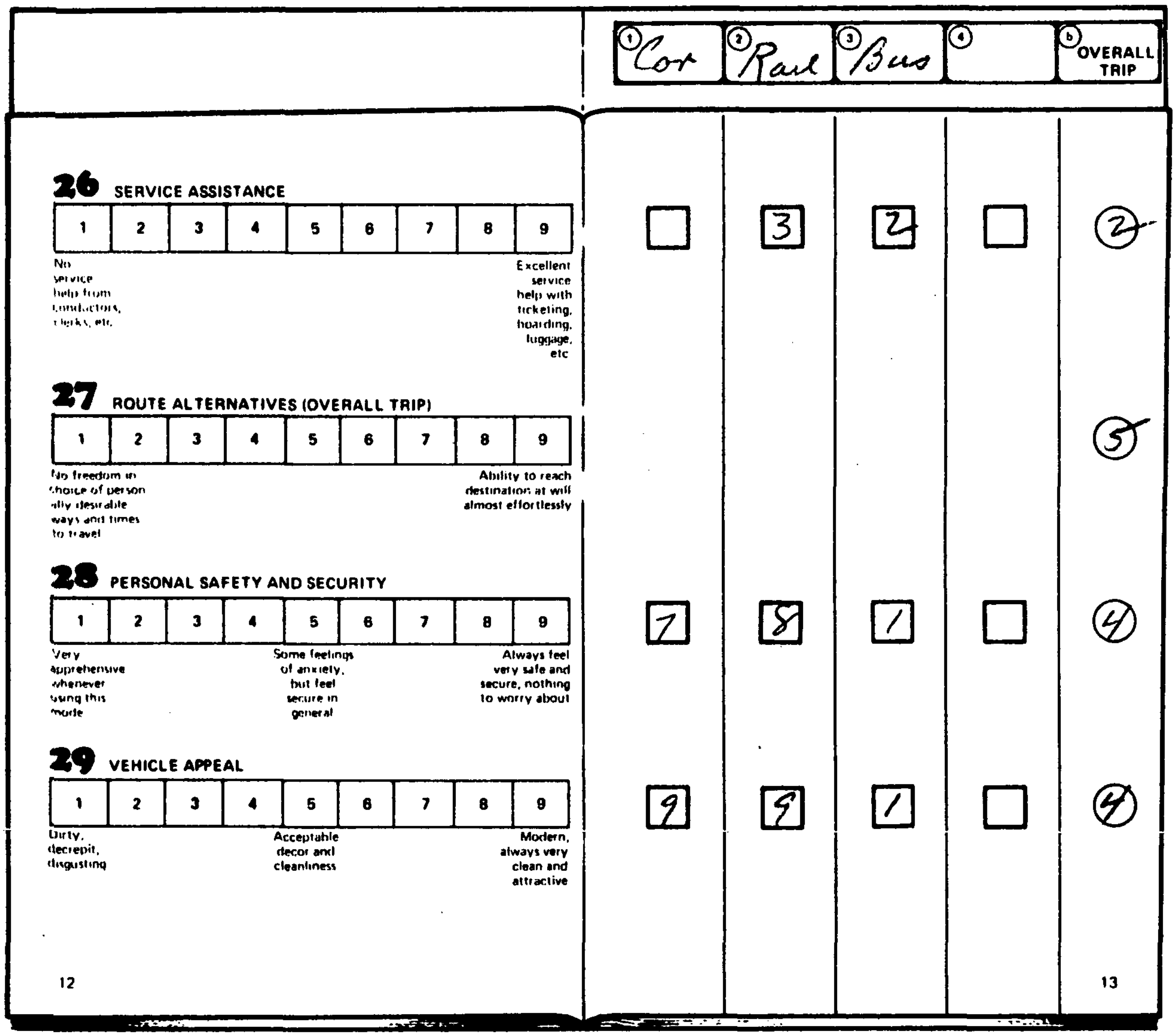
   Seat comfort
   Spaciousness and freedom of movement
   Parcel storage space
   Vehicle climate
   Smoothness of ride
   Physical side effects
   Noise level in vehicle
   Vehicle appeal

The rating scale approach used was adapted from the stanine scale approach used successfully in psychological research. Specially devised verbal descriptors are used for the more important scales to insure a greater consistency of response by travelers using the scales. Figure 4.1 illustrates portions of the feature rating form.

The distributions of the verbal descriptors (that is, the selection and association of verbal descriptors with the nine integer scale), were based on judgments from a sample of experienced travelers as to how well or badly particular phrases described a trip feature.

Instructions for the use of the forms are shown in Figure 4.2 The important thing to note at this point is that the survey participant is invited to indicate a measure of how he *feels* about these trip features by selecting a number from the scale that is associated with a particular verbal descriptor (or, in some cases with his own personal interpolation between those provided).

The adaptation of stanine scales used in this survey is a simplification of those usually used. Only two, three or five verbal descriptors are provided for each scale. This was done solely to reduce clutter on the page and keep the form as simple as possible. In usual practice, a verbal descriptor would be associated with each integer of the scale.



	① Car	② Rail	③ Bus	④	⑤ OVERALL TRIP
26		3	2		2
27					5
28	7	8	1		4
29	9	9	1		4

26 SERVICE ASSISTANCE

1	2	3	4	5	6	7	8	9

No service help from conductors, clerks, etc. — Excellent service help with ticketing, boarding, luggage, etc

27 ROUTE ALTERNATIVES (OVERALL TRIP)

1	2	3	4	5	6	7	8	9

No freedom in choice of personally desirable ways and times to travel — Ability to reach destination at will almost effortlessly

28 PERSONAL SAFETY AND SECURITY

1	2	3	4	5	6	7	8	9

Very apprehensive whenever using this mode — Some feelings of anxiety, but feel secure in general — Always feel very safe and secure, nothing to worry about

29 VEHICLE APPEAL

1	2	3	4	5	6	7	8	9

Dirty, decrepit, disgusting — Acceptable decor and cleanliness — Modern, always very clean and attractive

12 13

FIGURE 4.1: ILLUSTRATION OF RATING SCALES USED IN SURVEY

We need your help.

We are trying to make travel within the Bay Area more comfortable and *convenient. You can help by telling us how you feel about various features* of your local trips.

Please use this form to rate the trip you are making now, or the trip most recently completed before you received the form.

Space is provided at the end of the form so you can comment freely, if you wish. We sincerely invite your opinion.

INSTRUCTIONS

In the four columns below, circle the modes of transportation you use to get from your home (or office, etc.) to this trip's destination.

LEFT HOME (OFFICE, ETC.) BY . . .	INTERMEDIATE TRANSFER (IF APPLICABLE)		ARRIVAL MODE IF DIFFERENT
	TRANS. ONE	TRANS. TWO	
Walk 5 Min. or More	Rail	Rail	Walk 5 Min. or More
Cycle	Bus	Bus	Cycle
Taxi	Air	Air	Taxi
Drive Household Car, Truck	Helicopter	Helicopter	Bus
Bus/Streetcar	Car Pool	Ferry	
Car Pool	Ferry		
Family Drop Off or Chaffeur			
1	2	3	4

Now that you have circled your mode or modes of transportation (any or all columns 1-4), write the words you've circled in the same numbered columns at the top of the next page. For example, if you walked from home to the bus, then took a taxi to complete your trip, the top of the opposite page would read:

1	2	3	4	5
Walk	Bus		Taxi	OVERALL TRIP

1	2	3	4	5
Car	Rail	Bus		OVERALL TRIP

On the following pages you will find a series of trip feature rating scales that look like this, for example

TRIP TIME

1	2	3	4	5	6	7	8	9
Poor		Fair		Good		Very good		Excellent

We would like you to rate each feature by choosing a number from one to nine that comes closest to describing how you feel about the feature. Do this separately for each of the travel modes you circled above.

Place your rating number in the box in the appropriate column to the right of each scale. For example, if you had written "walk" in column one, "bus" in column two, and "taxi" in column 4, and left the remaining column empty, your typical rating would look like this

TRIP TIME

1	2	3	4	5	6	7	8	9	Walk	Bus		Taxi	Overall Trip
Poor		Fair		Good		Very good		Excellent	8	3		7	5

Notice that there is a fifth column labeled "Overall Trip." In column five, place the rating number that best describes your feeling about the feature with respect to your entire trip

If you feel that a feature rating scale is not applicable to any one of your travel modes, please ignore it for that mode

Please turn the page to the first scale and begin.

FIGURE 4.2: INSTRUCTIONS FOR USE OF SURVEY FORM

The scales are, in effect, nine equal intervals distributed over verbal descriptors in such a way that the most probable choice of a rater corresponds to the fifth interval and the remaining intervals correspond to a normal distribution of descriptors about the most probable value. The outstanding feature of the stanine scaling procedure is that it permits a rater to indicate a reasonably fine degree of preference or satisfaction rather than merely a "like - don't like" response. Furthermore, the statistical theory underlying the construction of the scale is compatible with their use as observations on variables in a regression model.

In addition to rating scales, the survey form includes multiple choice questions designed to capture information about the traveler's trip experience, the nature of the trip itself, the existence of route alternatives, and the traveler's satisfaction with his trip mode combination in terms of a schedule and cost penalty. The form is concluded with an invitation to the traveler to provide some socio-economic information about himself and to contribute his open-end comments. A facsimile of the survey form is attached as Appendix B.

4.3 BAY AREA SURVEY METHODS

The success of the preference survey was dependent upon the cooperation of the people and the businesses of San Francisco Bay Area. In particular, assistance of the following people and businesses was appreciated:

The late George Hanson, Manager of NORCALSTOL, The Greater San Francisco Chamber of Commerce, San Francisco

D. R. Hobson, Vice President - Headquarters Administration, Bank of America, San Francisco

Ivan W. Nealon, Executive Engineer and Robert Repp of Bechtel Incorporated, San Francisco

Robert R. Gros, Vice President - Public Relations, Pacific Gas and Electric Company, San Francisco

Tito Sasaki, Transportation Planner, Golden Gate Bridge, Highway, and Transportation District, San Francisco

George Housman, Manager, Commute Traffic, Southern Pacific Transportation Company, San Francisco

Eric Gehring and David Brown, Wells Fargo Bank, Oakland

R. L. Salsibury, Vice President, Sales and Service, and A. G. Tobey, Vice President of Operations, SFO Helicopter Airlines, Inc., Oakland

Susan M. Norman, Aerospace Engineer, National Aeronautics and Space Administration, Moffett Field

The approach used in the survey was to distribute a large number of forms to businesses around the Bay Area in a manner which was representative of the travel demand distribution. That is, a total of 2250 forms were distributed to businesses in San Francisco, 500 in Oakland, and 200 in San Jose (Moffett Field). It was anticipated that this technique would cover all the major modes of automobile, car pool, and bus, and that some returns would be received from rail and ferry travelers. However, no returns were expected from the helicopter and the rail and ferry returns were expected to be light. For this reason, an additional mode survey was made of the ferry, rail, and helicopter travelers. The overall results are listed in Table 4.1.

The overall rate of return of over 50% was considered to be very gratifying considering the length and complexity of the form. All forms were completed without assistance from the survey workers. The rate of return of forms distributed within businesses was from 45% to 70%. The low return rate for Oakland was due to one sample batch not being returned.

The variation in the return rate for the mode survey is a direct function of the time available for completing the form. The rail survey was carefully chosen to maximize the time available for each traveler. The train chosen left San Francisco for San Jose with a first stop at California Avenue. The minimum time available to complete the form was over 30 minutes and a maximum time of over an hour. With this time available the traveler was able to complete the form on the train. However, with the ferry and helicopter, insufficient time was available for the traveler to complete the form on the trip and the form had to be completed later and returned by mail. The return rate in these cases is related to the trip time, which is 20 to 25 minutes for the ferry and 10 to 15 minutes for the helicopter.

4.4 STATISTICS OF THE SURVEY SAMPLE POPULATION OF TRIPS AND RESPONDENTS

A look at the use of travel modes by different classes of the survey respondents is of interest in order to insure that the sample of trips (and trip respondents) is not abnormal in any sense. Classes are determined by stratifying the respondents into appropriate levels of the following demographic categories:

Table 4.1 Summary of Number of Survey Forms Distributed and Returned

Area	Number of Forms Distributed	Number of Forms Returned	Percentage Returned
San Francisco	2250	1344	59.7
Oakland	500	113	22.6
San Jose	200	96	48.5
Ferry	225	90	40.0
Rail	135	96	71.1
Helicopter	167	40	24.0
Overall	3477	1779	51.2

1. Sex
2. Age
3. Marital Status
4. Education
5. Yearly family income before taxes
6. Number of automobiles (including trucks and campers) owned or available

The levels for each category are shown in the survey form (see Appendix B), and are referred to as traveler characteristics. The following abbreviations are used for the non-numeric characteristics:

M	Male
F	Female
S	Single
M (NC)	Married, no children
S (C)	Single, one or more children
M (C)	Married, one or more children
W	Widowed
<HS	Did not complete high school
HS	Completed high school
<C	Some college
C	Completed college
HD	One or more higher degrees

The travel modes included in the analysis (in descending order of frequency of usage) are:

1. Bus, including street car and cable car.
2. Final walk.
3. Automobiles, including truck and camper.
4. Initial walk.
5. Rail.
6. Car pool.
7. Family drop off.
8. Ferry.
9. Air.
10. Cycle.
11. Taxi.
12. Helicopter.

Since most of the respondents used more than one mode to complete their trips from origin to destination, a respondent making a segment of his or her trip on one mode is referred to as a traveler. Consequently, the total number of travelers is equal to the total number of respondent/mode combinations, and is greater than the total number of respondents.

The distributions of travelers by travel mode and by traveler characteristic, for each demographic category, are shown in Table 4.2. For example, it can be seen that 720 male travelers and 465 female travelers used the bus. Also shown in the table are the row totals, column totals and grand total for each category, and the distribution by mode for all travelers. For example, it can be seen that in the sex category 106 travelers used the ferry, 2633 of the travelers were male and the total number of travelers was 3886. It should be noted that the corresponding row totals and the grand totals differ between categories, and are less than or equal to the corresponding numbers in the 'all travelers' category. The differences are due to incomplete response to the survey. For example, the grand totals show that out of 4052 travelers, 118 (3 percent) did not answer the age question and 318 (7 percent) did not answer the income question. Again it should be noted that a respondent is recorded as a traveler in Table 4.2 as many times as the number of modes he used in his reported trip. Therefore, the total number of travelers is greater than the total number of respondents. The distribution of travelers by number of modes used and by type of mode is shown in Table 4.3, and is presented pictorially in Figure 4.3 for the six modes of principal interest.

Returning to Table 4.2 it can be seen that only two of the travelers were under 18 years of age, and only two were over 65 years of age, therefore nothing can be deduced about the selection of travel modes by travelers in these two classes. However, all the other classes, and all the travel modes, contain sufficient response to enable distributions by traveler characteristic and by travel mode to be determined and compared.

The highlights of the data in Table 4.2 are presented pictorially in Figures 4.4 to 4.6 and show the distributions of travelers, for each demographic category, by traveler characteristic and by the six principal travel modes: bus, auto, rail, car pool, ferry and helicopter.

In order to compare the distributions of traveler characteristics within the different travel modes, the data in Table 4.2 has been normalized to 100 by row, to give the results shown in Table 4.4. For example, it can be seen that in the sex category 60.8 percent of the bus travelers were male and 39.2 percent were female, whereas 79.3 percent of the rail travelers were male and 20.7 percent were female. Also shown are the percentage distributions for all modes and the average for all modes. For example, the bus and rail distributions above can be compared with the distribution 67.8 percent male and 32.2 percent female for travelers on all modes.

TABLE 4.2

DISTRIBUTION OF TRAVELERS BY TRAVEL MODE AND BY TRAVELER CHARACTERISTIC

MODE	NUMBER OF AUTOS OWNED					AGE									MARITAL STATUS					
	0	1	2	>2	Total	<18	18-21	22-25	26-35	36-45	46-55	56-65	>65	Total	S	M(NC)	S(C)	M(C)	W	Total
BUS	168	564	372	72	1176	0	77	182	350	266	231	91	0	1197	330	264	44	539	22	1199
FINAL WALK	64	368	272	48	752	0	50	100	235	180	140	50	0	755	184	152	24	384	8	752
AUTO	18	207	414	72	711	0	20	80	215	180	175	50	0	720	108	144	18	441	9	720
INITIAL WALK	90	250	110	25	475	0	36	72	135	108	90	30	0	471	160	96	24	196	4	480
RAIL	12	84	114	21	231	0	8	26	60	54	62	26	2	238	30	48	3	147	3	231
CAR POOL	8	62	68	14	152	0	5	10	42	45	36	15	0	153	15	18	3	111	0	147
FAMILY DROP-OFF	2	74	44	12	132	0	7	19	38	27	26	13	0	130	14	28	4	84	2	132
FERRY	10	52	38	7	106	2	2	13	45	21	15	9	0	107	36	22	3	43	3	107
AIR	4	10	30	6	51	0	2	5	11	15	16	2	0	51	7	10	0	34	0	51
CYCLE	6	20	13	4	43	0	3	3	21	6	9	1	0	43	10	6	1	26	0	43
TAXI	8	7	18	4	37	0	1	1	9	7	13	7	0	38	6	8	0	23	1	38
HELICOPTER	1	6	20	3	30	0	2	1	5	10	8	5	0	31	4	5	2	10	1	31
TOTAL	391	1704	1513	288	3896	2	213	512	1166	919	821	299	2	3934	904	801	126	2047	53	3931

MODE	EDUCATION						INCOME ($ Thousands/Year)										SEX			ALL TRAVELERS
	<HS	HS	<C	C	HD	Total	<5	5-7.5	7.5-10	10-12.5	12.5-15	15-20	20-25	25-40	>40	Total	M	F	Total	
BUS	18	162	360	423	225	1188	30	150	120	144	156	294	144	85	6	1128	720	465	1185	1230
FINAL WALK	6	92	234	264	156	750	12	72	72	96	104	184	104	64	8	716	506	231	737	778
AUTO	6	95	228	252	138	720	8	32	52	76	112	196	116	92	8	692	517	198	715	744
INITIAL WALK	8	68	152	160	88	476	15	66	54	63	57	105	54	33	6	453	288	180	468	482
RAIL	2	22	56	84	70	234	2	14	10	28	32	64	36	34	4	224	184	48	232	244
CAR POOL	2	22	56	56	18	154	0	8	6	13	27	42	23	17	2	138	129	21	150	154
FAMILY DROP-OFF	0	12	44	52	24	132	4	5	4	23	16	39	17	17	2	127	94	36	130	139
FERRY	1	4	22	42	36	105	6	6	7	10	10	20	18	19	6	102	78	28	106	110
AIR	0	10	11	15	15	51	2	1	2	4	5	17	4	13	1	49	35	16	51	53
CYCLE	0	4	10	13	16	43	2	2	4	8	8	7	6	4	0	41	33	10	43	43
TAXI	0	7	10	10	10	37	1	1	1	3	3	10	6	10	1	36	27	11	38	42
HELICOPTER	0	4	9	8	9	30	2	0	0	5	2	5	6	7	1	28	22	9	31	33
TOTAL	43	501	1192	1379	805	3920	84	357	332	473	532	983	534	394	45	3734	2633	1253	3886	4052

TABLE 4.3

DISTRIBUTION OF TRAVELLERS BY NUMBER OF MODES USED AND BY TRAVEL MODE

MODE	Number of Modes Used				TOTAL
	1	2	3	> 3	
Bus	122	305	603	200	1230
Final Walk	0	136	518	124	778
Auto	211	157	282	94	744
Initial Walk	18	100	307	57	482
Rail	2	11	152	79	244
Car Pool	63	38	48	2	151
Family Drop-off	10	23	83	23	139
Ferry	5	14	56	35	110
Air	1	5	20	27	53
Cycle	2	7	29	5	43
Taxi	0	2	21	19	42
Helicopter	6	4	8	15	33
TOTAL	440	802	2127	680	4049

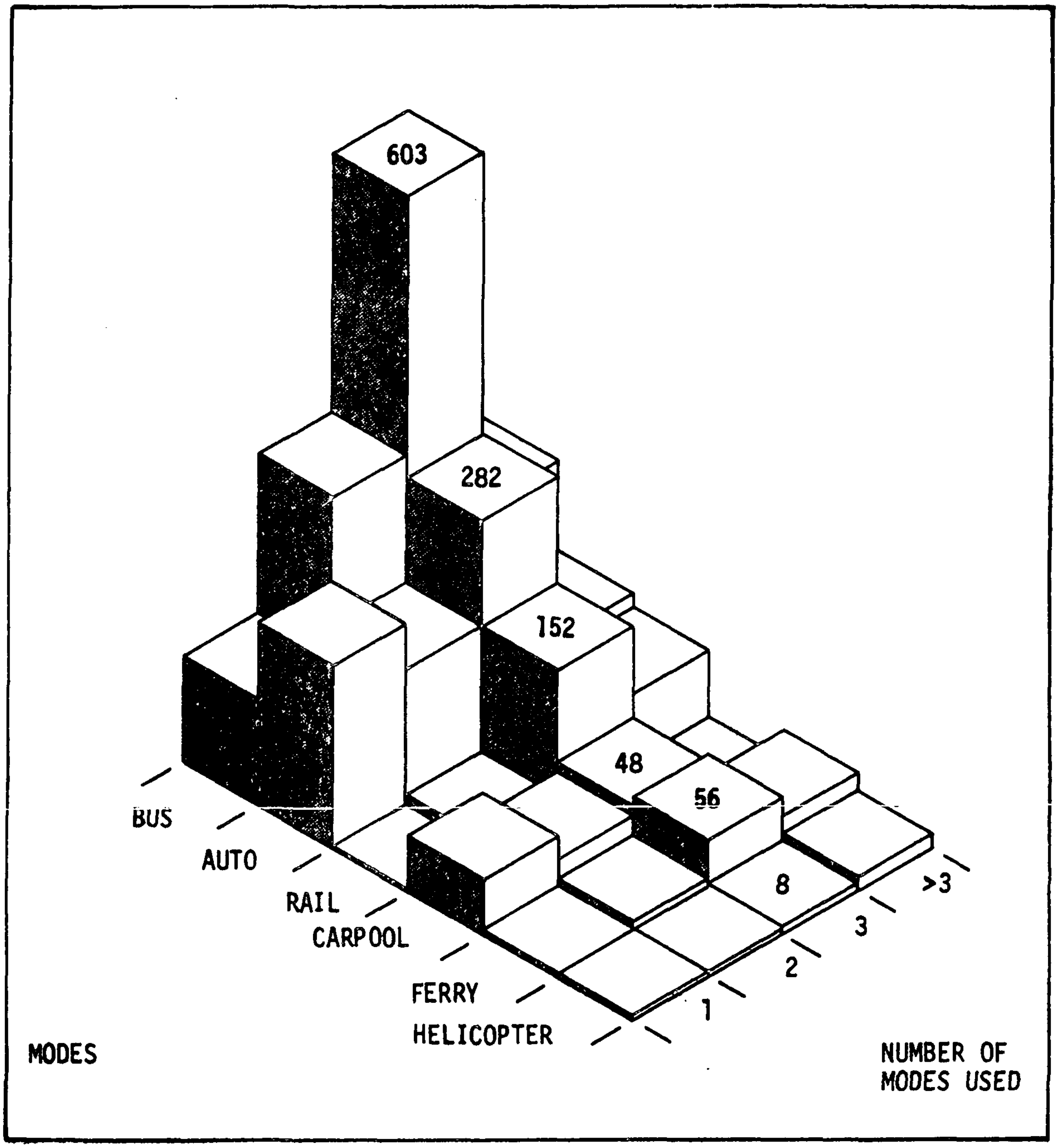


FIGURE 4.3
HISTOGRAM ILLUSTRATING DISTRIBUTION OF TRAVELERS BY NUMBER OF MODES USED AND BY TYPE OF MODE

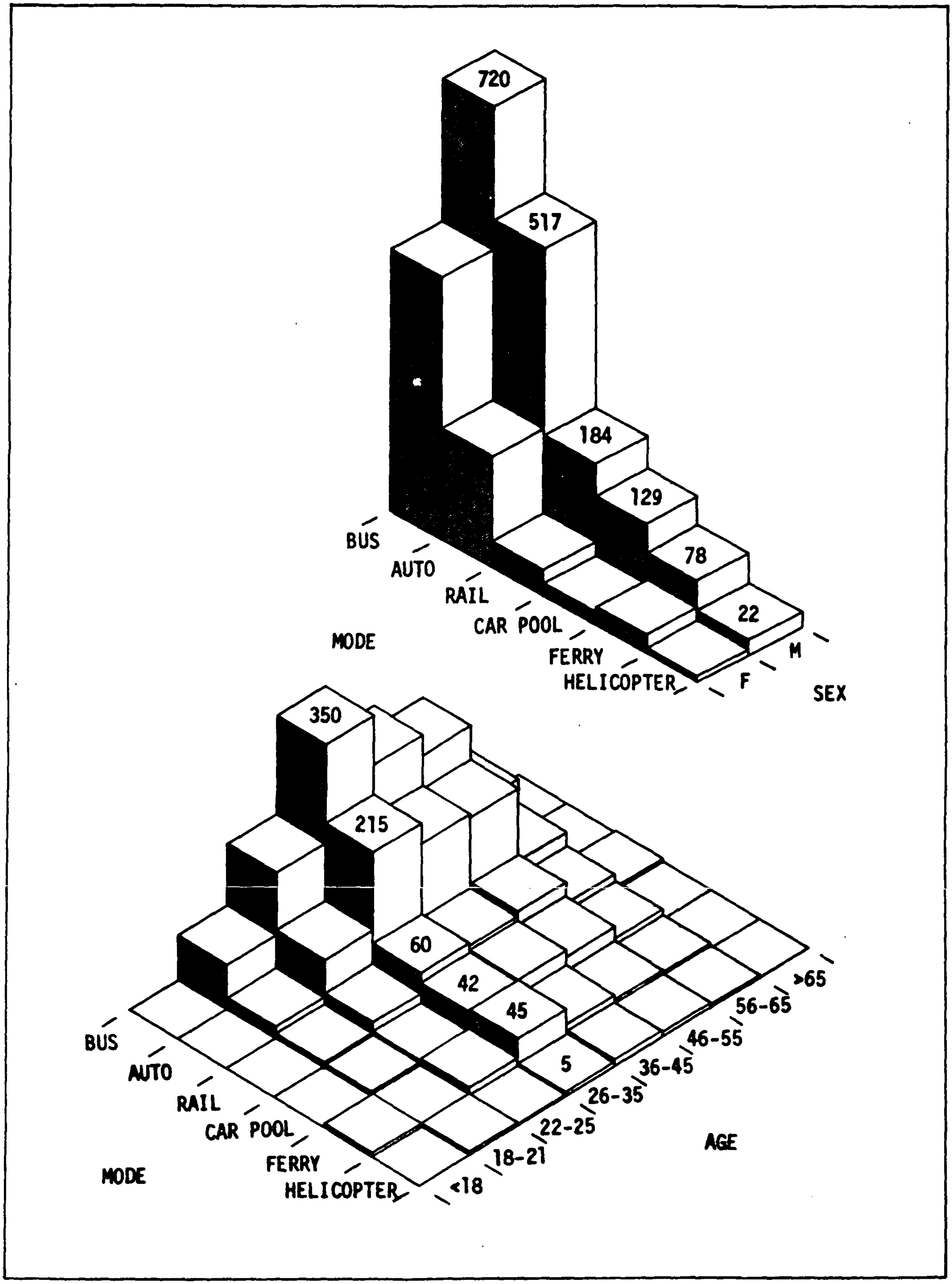


Figure 4.4 Histograms Illustrating Traveler Distribution by Sex and Age

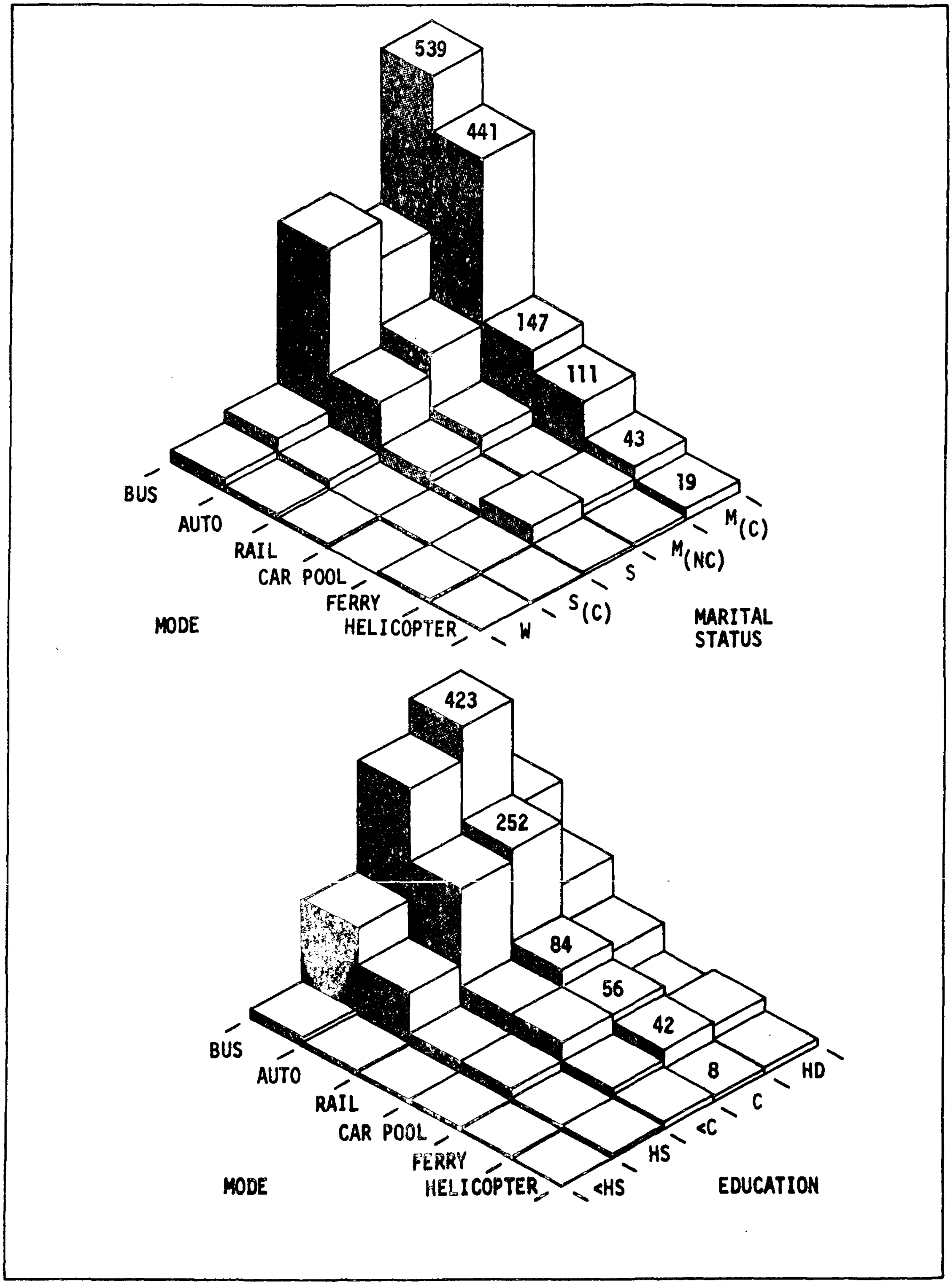
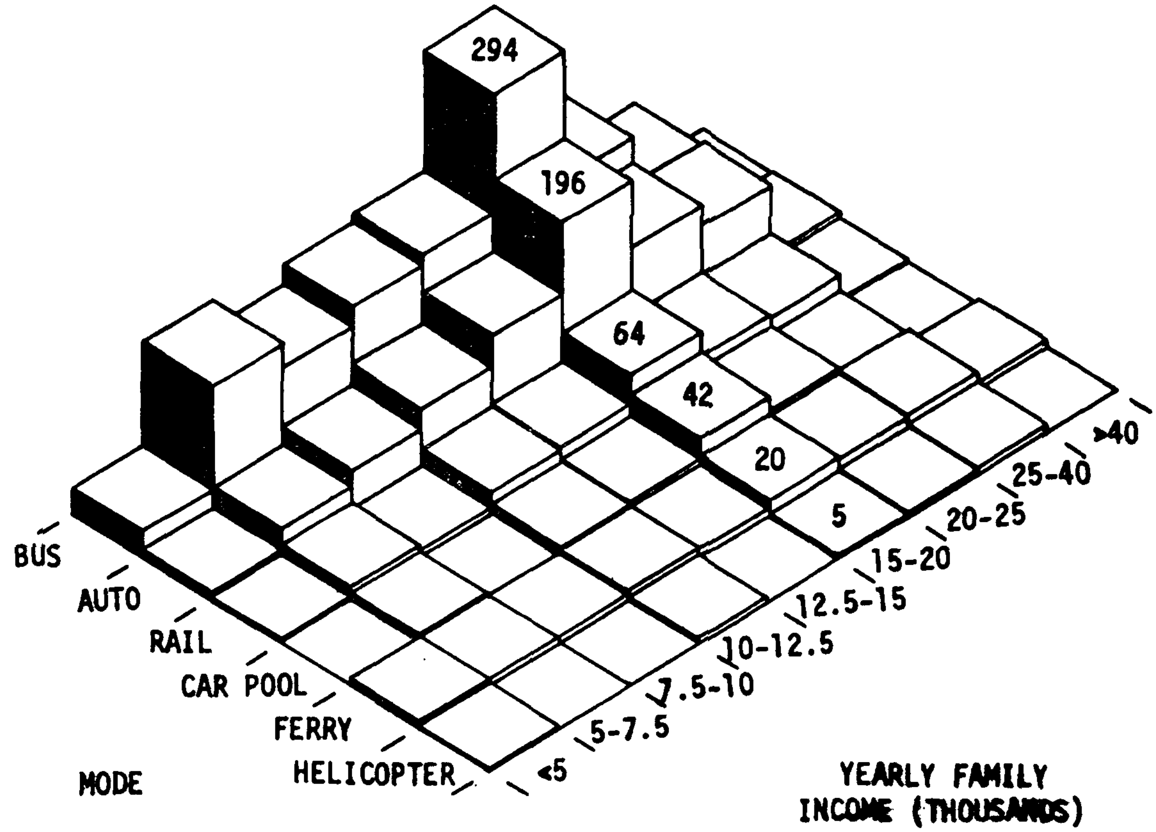


Figure 4.5 Histograms Illustrating Traveler Distribution by Marital Status and Education



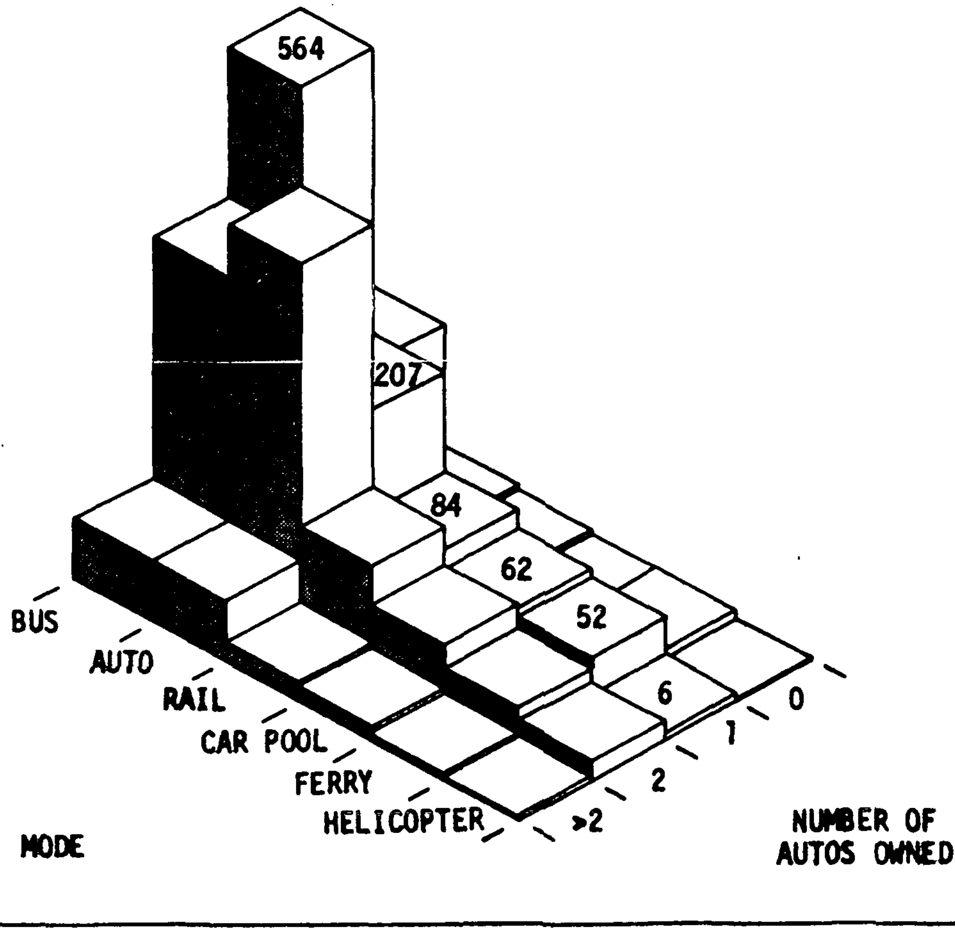


Figure 4.6 Histograms Illustrating Traveler Distribution by Yearly Family Income and Number of Autos Owned

In order to compare the distributions of travel modes within the different traveler characteristics, the data in Table 4.2 has been normalized to 100 by column, to give the results shown in Table 4.5. For example, it can be seen that 27.4 percent of the male travelers used the bus and 7.0 percent used rail, whereas 37.1 percent of the female travelers used the bus and only 3.8 percent used rail. These percentages can be compared with the corresponding percentages for all the travelers, 30.4 percent of whom used the bus, and 6.0 percent used rail.

Table 4.4 shows how the travelers were distributed by characteristic within a mode, but does not show how the travelers were distributed by mode within a characteristic. Conversely, Table 4.5 shows the distributions by mode, but not by characteristic. In order to show the joint distributions, the data for each category in Table 4.2 have been normalized to 100 by the total number of travelers in each category, to give the results shown in Table 4.6. For example, it can be seen that of the total number of travelers in the sex category, 18.5 percent were male bus travelers, 12.0 percent were female bus travelers, 4.7 percent were male rail travelers and 1.2 percent were female rail travelers. The row and column totals show the percentages of the total travelers using each mode and belonging to each characteristic, respectively. For example, in the sex category, 18.4 percent of all the travelers traveled by automobile, and 67.8 percent of all travelers were male.

The sample is quite uniform with respect to the nature of the trips that were rated. The trip described by the overwhelming majority of respondents was one of going to work in the morning, traveling alone. Obviously, in these respects, the sample is an excellent representation of workday commuting trips, which is of prime interest in this study.

Distributions of age, family income, education, and number of autos available show that the sample is largely composed of young, fairly affluent, well educated and mobile people. In short, there are no abnormalities in the sample that would greatly bias results. A summary of trip description statistics is shown in Figure 4.7.

4.5 OPEN-END COMMENTS

At the end of the survey form respondents were invited to list and comment on any factors important to their selection of travel modes which were not covered in the survey. These factors and comments are referred to as open-end comments.

TABLE 4.4

PERCENTAGE DISTRIBUTIONS OF TRAVELER CHARACTERISTICS WITHIN TRAVEL MODE

MODE	NUMBER OF AUTOS OWNED					AGE									MARITAL STATUS					
	0	1	2	>2	Total	<18	18-21	22-25	26-35	36-45	46-55	56-65	>65	Total	S	M(NC)	S(C)	M(C)	W	Total
BUS	14.3	48.0	31.6	6.1	100	0	6.4	15.2	29.2	22.2	19.3	7.6	0	100	27.5	22.0	3.7	45.0	1.8	100
FINAL WALK	8.5	48.9	36.2	6.4	100	0	6.6	13.3	31.1	23.8	18.5	6.6	0	100	24.5	20.2	3.2	51.1	1.1	100
AUTO	2.5	29.1	58.2	10.1	100	0	2.8	11.1	29.9	25.0	24.3	6.9	0	100	15.0	20.0	2.5	61.3	1.3	100
INITIAL WALK	19.0	52.6	23.2	5.3	100	0	7.6	15.3	28.7	22.9	19.1	6.4	0	100	33.3	20.0	5.0	40.8	0.8	100
RAIL	5.2	36.4	49.4	9.1	100	0	3.4	10.9	25.2	22.7	26.1	10.9	0.8	100	13.0	20.8	1.3	63.6	1.3	100
CAR POOL	5.3	40.8	44.7	9.2	100	0	3.3	6.5	27.5	29.4	23.5	9.8	0	100	10.2	12.2	2.0	75.5	0	100
FAMILY DROP-OFF	1.5	56.1	33.3	9.1	100	0	5.4	14.6	29.2	20.8	20.0	10.0	0	100	10.6	21.2	3.0	63.6	1.5	100
FERRY	9.4	49.1	35.9	5.7	100	1.9	1.9	12.2	42.1	19.6	14.0	8.4	0	100	33.6	20.6	2.8	40.2	2.8	100
AIR	7.8	19.6	58.8	13.7	100	0	3.9	9.8	21.6	29.4	31.4	3.9	0	100	13.7	19.6	0	66.7	0	100
CYCLE	14.0	46.5	30.2	9.3	100	0	7.0	7.0	48.8	14.0	20.9	2.3	0	100	23.3	14.0	2.3	60.5	0	100
TAXI	21.6	18.9	48.7	10.8	100	0	2.6	2.6	23.7	18.4	34.2	18.4	0	100	15.8	21.1	0	60.5	2.6	100
HELICOPTER	3.3	20.0	66.7	10.0	100	0	6.5	3.2	16.1	32.3	25.8	16.1	0	100	12.9	16.1	6.5	61.3	3.2	100
ALL MODES	10.0	43.8	38.8	7.4	100	0.1	5.4	13.0	29.6	23.3	20.9	7.6	0.1	100	23.0	20.4	3.2	52.1	1.3	100

MODE	EDUCATION						INCOME ($ Thousands/Year)										SEX		
	<HS	HS	<C	C	HD	Total	<5	5-7.5	7.5-10	10-12.5	12.5-15	15-20	20-25	25-40	>40	Total	M	F	Total
BUS	1.5	13.6	30.3	35.6	18.9	100	2.7	13.3	10.6	12.8	13.8	26.1	12.8	7.5	0.5	100	60.8	39.2	100
FINAL WALK	0.8	12.0	31.2	35.2	20.8	100	1.7	10.1	10.1	13.4	14.5	25.7	14.5	8.9	1.1	100	68.7	31.3	100
AUTO	0.8	13.3	31.7	35.0	19.2	100	1.2	4.6	7.5	11.0	16.2	28.3	16.8	13.3	1.2	100	72.3	27.7	100
INITIAL WALK	1.7	14.3	31.9	33.6	18.5	100	3.3	14.6	11.9	13.9	12.6	23.2	11.9	7.3	1.3	100	61.5	38.5	100
RAIL	0.9	9.4	23.9	35.9	29.9	100	0.9	6.3	4.5	12.5	14.3	28.6	16.1	15.2	1.8	100	79.3	20.7	100
CAR POOL	1.3	14.3	36.4	36.4	11.7	100	0	5.8	4.4	9.4	19.6	30.4	16.7	12.3	1.5	100	86.0	14.0	100
FAMILY DROP-OFF	0	9.1	33.3	39.4	18.2	100	3.2	3.9	3.2	18.1	12.6	30.7	13.4	13.4	1.6	100	72.3	27.7	100
FERRY	1.0	3.8	21.0	40.0	34.3	100	5.9	5.9	6.9	9.8	9.8	19.6	17.7	18.6	5.9	100	73.6	26.4	100
AIR	0	19.6	21.6	29.4	29.4	100	4.1	2.0	4.1	8.2	10.2	34.7	8.2	26.5	2.0	100	68.6	31.4	100
CYCLE	0	9.3	23.3	30.2	37.2	100	4.9	4.9	9.8	19.5	19.5	17.1	14.6	9.8	0	100	76.7	23.3	100
TAXI	0	18.9	27.0	27.0	27.0	100	2.8	2.8	2.8	8.3	8.3	27.8	16.7	27.8	2.8	100	71.0	29.0	100
HELICOPTER	0	13.3	30.0	26.7	30.0	100	7.1	0	0	17.9	7.1	17.9	21.4	25.0	3.6	100	71.0	29.0	100
ALL MODES	1.1	12.8	30.4	35.2	20.5	100	2.2	9.6	8.9	12.7	14.2	26.3	14.3	10.6	1.2	100	67.8	32.2	100

TABLE 4.5

PERCENTAGE DISTRIBUTIONS OF TRAVEL MODES WITHIN TRAVELER CHARACTERISTICS

MODE	NUMBER OF AUTOS OWNED				AGE								MARITAL STATUS				
	0	1	2	>2	<18	18-21	22-25	26-35	36-45	46-55	56-65	>65	S	M(NC)	S(C)	M(C)	W
BUS	43.0	33.1	24.6	25.0		36.2	35.6	30.0	28.9	28.1	30.4		36.5	33.0	34.9	26.3	41.5
FINAL WALK	16.4	21.6	18.0	16.7		23.5	19.5	20.2	19.6	17.1	16.7		20.4	19.0	19.1	18.8	15.1
AUTO	4.6	12.2	27.4	25.0		9.4	15.6	18.4	19.6	21.3	16.7		12.0	18.0	14.3	21.5	17.0
INITIAL WALK	23.0	14.7	7.3	8.7		16.9	14.1	11.6	11.8	11.0	10.0		17.7	12.0	19.1	9.6	7.6
RAIL	3.1	4.9	7.5	7.3		3.8	5.1	5.2	5.9	7.6	8.7		3.3	6.0	2.4	7.2	5.7
CAR POOL	2.1	3.6	4.5	4.9		2.4	2.0	3.6	4.9	4.4	5.0		1.7	2.3	2.4	5.4	0
FAMILY DROP-OFF	0.5	4.3	2.9	4.2		3.3	3.7	3.3	2.9	3.2	4.4		1.6	3.5	3.2	4.1	3.8
FERRY	2.6	3.1	2.5	2.1		0.9	2.5	3.9	2.3	1.8	3.0		4.0	2.8	2.4	2.1	5.7
AIR	1.0	0.6	2.0	2.4		0.9	1.0	0.9	1.6	2.0	0.7		0.8	1.3	0	1.7	0
CYCLE	1.5	1.2	0.9	1.4		1.4	0.6	1.8	0.7	1.1	0.3		1.1	0.8	0.8	1.3	0
TAXI	2.1	0.4	1.2	1.4		0.5	0.2	0.8	0.8	1.6	2.3		0.7	1.0	0	1.1	1.9
HELICOPTER	0.3	0.4	1.3	1.0		0.9	0.2	0.4	1.1	1.0	1.7		0.4	0.6	1.6	0.9	1.9
TOTAL	100	100	100	100		100	100	100	100	100	100		100	100	100	100	100

MODE	EDUCATION					INCOME ($ Thousands/Year)									SEX		ALL TRAVELERS
	<HS	HS	<C	C	HD	<5	5-7.5	7.5-10	10-12.5	12.5-15	15-20	20-25	25-40	>40	M	F	
BUS	41.9	32.3	30.2	30.7	28.0	35.7	42.0	36.1	30.4	29.3	29.9	27.0	21.3	13.3	27.4	37.1	30.4
FINAL WALK	14.0	18.0	19.6	19.1	19.4	14.3	20.2	21.7	20.3	19.6	18.7	19.5	16.2	17.8	19.2	18.4	19.2
AUTO	14.0	19.2	19.1	18.3	17.1	9.5	9.0	15.7	16.1	21.1	19.9	21.7	23.4	17.8	19.6	15.8	18.4
INITIAL WALK	18.6	13.6	12.8	11.6	10.9	17.9	18.5	16.3	13.3	10.7	10.7	10.1	8.4	13.3	10.9	14.4	11.9
RAIL	4.7	4.4	4.7	6.1	8.7	2.4	3.9	3.0	5.9	6.0	6.5	6.7	8.6	8.9	7.0	3.8	6.0
CAR POOL	4.7	4.4	4.7	4.1	2.2	0	2.2	1.8	2.8	5.1	4.3	4.3	4.3	4.4	4.9	1.7	3.8
FAMILY DROP-OFF	0	2.4	3.7	3.8	3.0	4.8	1.4	1.2	4.9	3.0	4.0	3.2	4.3	4.4	3.6	2.9	3.4
FERRY	2.3	0.8	1.9	3.1	4.5	7.1	1.7	2.1	2.1	1.9	2.0	3.4	4.8	13.3	3.0	2.2	2.7
AIR	0	2.0	0.9	1.1	1.9	2.4	0.3	0.6	0.9	0.9	1.7	0.8	3.3	2.2	1.3	1.3	1.3
CYCLE	0	0.8	0.8	0.9	2.0	2.4	0.6	1.2	1.7	1.5	0.7	1.1	1.0	0	1.3	0.8	1.1
TAXI	0	1.4	0.8	0.7	1.2	1.2	0.3	0.3	0.6	0.6	1.0	1.1	2.5	2.2	1.0	0.9	1.0
HELICOPTER	0	0.8	0.8	0.6	1.1	2.4	0	0	1.1	0.4	0.5	1.1	1.8	2.2	0.8	0.7	0.8
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

TABLE 4.6

PERCENTAGE DISTRIBUTIONS OF TRAVELERS BY TRAVEL MODE AND BY TRAVELER CHARACTERISTIC

MODE	NUMBER OF AUTOS OWNED					AGE									MARITAL STATUS					
	0	1	2	>2	Total	<18	18-21	22-25	26-35	36-45	46-55	56-65	>65	Total	S	M(NC)	S(C)	M(C)	W	Total
BUS	4.3	14.5	9.6	1.9	30.2		2.0	4.6	8.9	6.8	5.9	2.3		30.4	8.4	6.7	1.1	13.7	0.6	30.5
FINAL WALK	1.6	9.5	7.0	1.2	19.3		1.3	2.5	6.0	4.6	3.6	1.3		19.2	4.7	3.9	0.6	9.8	0.2	19.1
AUTO	0.5	5.3	10.6	1.9	18.2		0.5	2.0	5.5	4.6	4.5	1.3		18.3	2.8	3.7	0.5	11.2	0.2	18.3
INITIAL WALK	2.3	6.4	2.8	0.6	12.2		0.9	1.8	3.4	2.8	2.3	0.8		12.0	4.1	2.4	0.6	5.0	0.1	12.2
RAIL	0.3	2.2	2.9	0.5	5.9		0.2	0.7	1.5	1.4	1.6	0.7		6.0	0.8	1.2	0.1	3.7	0.1	5.9
CAR POOL	0.2	1.6	1.8	0.5	3.9		0.1	0.3	1.1	1.1	0.9	0.4		3.9	0.4	0.5	0.1	2.8	0	3.7
FAMILY DROP-OFF	0.1	1.9	1.1	0.3	3.4		0.2	0.5	1.0	0.7	0.7	0.3		3.3	0.4	0.7	0.1	2.1	0.1	3.4
FERRY	0.3	1.3	1.0	0.2	2.7		0.1	0.3	1.1	0.5	0.4	0.2		2.7	0.9	0.6	0.1	1.1	0.1	2.7
AIR	0.1	0.3	0.8	0.2	1.3		0.1	0.1	0.3	0.4	0.4	0.1		1.3	0.2	0.3	0	0.9	0	1.3
CYCLE	0.2	0.5	0.3	0.1	1.1		0.1	0.1	0.5	0.2	0.2	0		1.1	0.3	0.2	0	0.7	0	1.1
TAXI	0.2	0.2	0.5	0.1	0.9		0	0	0.2	0.2	0.3	0.2		1.0	0.2	0.2	0	0.6	0	1.0
HELICOPTER	0	0.2	0.5	0.1	0.8		0.1	0	0.1	0.3	0.2	0.1		0.8	0.1	0.1	0.1	0.5	0	0.8
TOTAL	10.0	43.7	38.8	7.4	100		5.5	13.0	29.6	23.4	20.9	7.7		100	23.0	20.4	3.2	52.0	1.3	100

MODE	EDUCATION						INCOME ($ Thousands/Year)										SEX		
	<HS	HS	<C	C	HD	Total	<5	5-7.5	7.5-10	10-12.5	12.5-15	15-20	20-25	25-40	>40	Total	M	F	Total
BUS	0.5	4.1	9.2	10.8	5.7	30.3	0.8	4.0	3.2	3.9	4.2	7.9	3.9	2.3	0.2	30.2	18.5	12.0	30.5
FINAL WALK	0.2	2.3	6.0	6.7	4.0	19.1	0.3	1.9	1.9	2.6	2.8	4.9	2.8	1.7	0.2	19.2	13.0	5.9	19.0
AUTO	0.2	2.5	5.8	6.4	3.5	18.4	0.2	0.9	1.4	2.0	3.0	5.3	3.1	2.5	0.2	18.5	13.3	5.1	18.4
INITIAL WALK	0.2	1.7	3.9	4.1	2.2	12.1	0.4	1.8	1.5	1.7	1.5	2.8	1.5	0.9	0.2	12.1	7.4	4.6	12.0
RAIL	0.1	0.6	1.4	2.1	1.8	6.0	0.1	0.4	0.3	0.8	0.9	1.7	1.0	0.9	0.1	6.0	4.7	1.2	6.0
CAR POOL	0.1	0.6	1.4	1.4	0.5	3.9	0	0.2	0.2	0.4	0.7	1.1	0.6	0.5	0.1	3.7	3.3	0.5	3.9
FAMILY DROP-OFF	0	0.3	1.1	1.3	0.6	3.4	0.1	0.1	0.1	0.6	0.4	1.0	0.5	0.5	0.1	3.4	2.4	0.9	3.3
FERRY	0	0.1	0.6	1.1	0.9	2.7	0.2	0.2	0.2	0.3	0.3	0.5	0.5	0.5	0.2	2.7	2.0	0.7	2.7
AIR	0	0.3	0.3	0.4	0.4	1.3	0.1	0	0.1	0.1	0.1	0.5	0.1	0.4	0	1.3	0.9	0.4	1.3
CYCLE	0	0.1	0.3	0.3	0.4	1.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0	1.1	0.9	0.3	1.1
TAXI	0	0.2	0.3	0.3	0.3	0.9	0	0	0	0.1	0.1	0.3	0.2	0.3	0	1.0	0.7	0.3	1.0
HELICOPTER	0	0.1	0.2	0.2	0.2	0.8	0.1	0	0	0.1	0.1	0.1	0.2	0.2	0	0.7	0.6	0.2	0.8
TOTAL	1.1	12.8	30.4	35.1	20.5	100	2.2	9.6	8.9	12.7	14.2	26.3	14.3	10.6	1.2	100	67.8	32.2	100

How many times a week do you usually make a trip like the one you have just rated?

1	2	3	4	5 or more
4%	0%	2.6%	2.6%	90.8%

How many are in your group?

Alone	2	3	4-6	7 or more
76.9%	10.8%	3.1%	4.6%	4.6%

What time did you start out on your trip?

6:30-8:30 A.M.	4-6 P.M.
93.3%	6.7%

What was the purpose for your trip?

7.1%	Going home
87.5%	Going to work
1.8%	Work-related business
1.8%	On way to recreation
1.8%	Visit friends-relatives

Figure 4.7 Summary of Trip Description Statistics

Of the 1727 respondents who completed and returned the survey, 483 made a total of approximately 700 open-end comments. To read these comments in random order is a tedious task, and gives a confusing and conflicting picture of the respondents' attitudes to the different modes of travel and to the transportation system in general. The comments range from short to long, from serious to amusing, from specific to general, from construction to destructive, and from intelligent to unintelligible.

One of the first impressions gained from reading the comments is that the travelling public are seeking a transportation system with an infinite number of modes and routes, that will enable them to travel between any two points in the system, at any time of the day or night, in zero time, at zero cost, and in maximum comfort. With such a set of impossible objectives, any transportation system is bound to generate a lot of criticism, and the San Francisco Bay Area system is no exception. For example, a relatively large proportion of the comments are critical of the bus service. However, before condemning the bus service, it must be remembered that a relatively large proportion of the trips made were by bus, and thus they would be expected to generate a large proportion of both favorable and unfavorable comments.

In order to clarify the picture the comments have been categorized, summarized, and analyzed, so that the reader may obtain either a general overview of all the comments, or a more detailed view of the comments relating to any or all of the different travel modes.

Some respondents made one comment, others made several. Of the respondents making several comments, some referred to one mode, others to several. Some of the respondents referred to the transportation system in general, and a few made comments that were unclassifiable.

The comments are listed in Appendix C, and are categorized either by mode of travel, or as general or unclassified. The comments made by respondents who made several comments have not been separated, and are categorized by the principle mode of travel or category referred to, with a code letter added to cross reference the other categories. The categories and their code letters are shown in Table 4.7. Also shown are the number of respondents in each category who made comments referring solely or principally to that category. For example, it can be seen that 187 respondents made comments referring solely or principally to bus travel. Respondents who made secondary references to bus travel can be located in Appendix C by searching for the reference letter "B" in the right hand column.

TABLE 4.7

CATEGORIES AND CODES FOR OPEN-END COMMENTS

LISTED IN APPENDIX C

Category	Code	Number of Respondents
Bus, including street car	B	187
Automobile	A	80
Rail	R	24
Ferry	F	66
Helicopter	H	9
BART	BT	22
Cable Car	CC	5
Cycle	C	7
Taxi, including charter bus & jitney	T	7
Air	P	5
Walk	W	4
General	G	55
Unclassified	U	12
TOTAL		483

In order to provide a convenient overview of the comments in Appendix C, they have separated, summarized, and sorted into the categories shown in Table 4.8. Also shown in Table 4.8 is the number of times each comment was made. For example, it can be seen that the respondents made 54 "favorable" and 239 "unfavorable" comments about bus travel. The summaries of the comments themselves are shown in Table 4.9. It should be noted that although a "favorable" comment usually expresses a like for a mode, an "unfavorable" comment does not necessarily express a dislike--it may express a desire for the extension or improvement of a mode that is liked.

TABLE 4.8

FREQUENCY OF OPEN-END COMMENTS BY

PRINCIPAL MODES

Category	Favorable	Unfavorable
Bus	54	239
Auto	74	45
Rail	9	27
Ferry	47	74
Helicopter	5	7
TOTAL	189	392

Table 4.10 shows a comparison, for the principal modes and a group of the other modes, of the number of respondents using the mode or modes and the number of comments made. For example, it can be seen that the 1230 respondents who used the bus made 293 comments (ratio 23.8%), of which 54 were "favorable" (ratio 4.4%).

If the ratio of "favorable" comments to the number of respondents is taken as a measure of the popularity of a mode, the ferry is away ahead with 43 percent, followed by the automobile with 7 percent, and bus and rail with 4 percent each. The modes helicopter, air, cycle and taxi as a group are between auto and rail with 6 percent.

Examination of the comments in Appendix C, and of the various tables derived from them enables the following points of interest to be noted, in addition to those already mentioned:

1) Several respondents stated or implied that the available or proposed transportation system strongly influenced the selection of their places of residence.

2) Several respondents stated or implied that they would switch modes if there were a change in some factor such as cost, time, comfort, frequency of service or availability.

3) Many respondents made comments related to the adverse effect of some modes on the environment, and some deliberately chose modes that minimized pollution.

4) The coming of BART was referred to in 44 comments, and 17 respondents stated they were looking forward to using it.

TABLE 4.9

SUMMARY OF OPEN-END COMMENTS

1. Bus (including street car)

1.a. Favorable Comments

	Comment	Frequency
1.	Reasonably priced. Cheapest method of travel.	9
2.	Provides a good service.	9
3.	Satisfied with service provided.	6
4.	Good service in mornings.	6
5.	Drivers are courteous and friendly.	5
6.	Express services are good.	3
7.	Greyhound services are good.	3
8.	Enjoy reading on bus.	3
9.	Better than ferry in bad weather.	2
10.	Service is convenient and flexible.	2
11.	Quickest method of transport.	1
12.	Safer than walking.	1
13.	Reliable.	1
14.	A challenging adventure!	1
15.	Private communter bus enjoyable.	1
16.	Relaxing.	1
	Total favorable comments	54

1.b. Unfavorable Comments

	Comment	Frequency
1.	Crowded.	30
2.	Bumpy and uncomfortable.	24
3.	Schedules are badly planned, uncoordinated, not adhered to, changed without notice.	24
4.	Drivers are discourteous, inconsiderate, unfriendly, reckless, go through yellow lights, go through red lights, drive badly.	22
5.	Buses are smelly, smoky, and pollute the air.	16
6.	Poor service Sundays, holidays, evenings, nights.	14
7.	Noisy.	14
8.	Slow.	12
9.	Waiting places dark, badly located, unprotected from weather, unsafe.	10
10.	No fresh air, stuffy.	9
11.	Vehicles old, unreliable, unsafe.	9
12.	Service infrequent.	9
13.	Dirty, trash on floors.	7

TABLE 4.9 (Cont'd)

1. Bus (continued)

1.b. Unfavorable Comments (continued)

		Frequency
14.	Unpleasant, dislike, intolerable.	7
15.	Passengers objectionable, discourteous.	6
16.	Fares too high.	6
17.	Passengers sometimes have to get out and walk up steep hills.	4
18.	Smokers objectionable.	4
19.	Not enough routes.	3
20.	Seats ripped.	2
21.	No auto parking at bus stops.	2
22.	Special bus lanes needed.	2
23.	Not enough express services.	1
24.	Prefer to walk.	1
25.	Greyhound depot needs rennovating or relocating.	1
	Total unfavorable comments	239

2. Automobile

2.a. Favorable Comments

1.	Only method of transportation available.	28
2.	Quick, convenient.	22
3.	Flexible, readily available.	5
4.	Cheapest method of transportation.	4
5.	Preferred to other modes.	3
6.	Need in course of work.	3
7.	Only method of transportation for disabled.	3
8.	Car pool cheapest and best.	3
9.	Can think, plan, listen to radio.	1
10.	Reasonably priced parking available.	1
11.	Second car cheaper than using bus.	1
	Total favorable comments	74

2.b. Unfavorable Comments

1.	Expensive to operate and park.	19
2.	Results in psychological wear and tear, tension, exasperation.	6
3.	Dislike driving.	4
4.	Highways too congested.	4
5.	Is a waste of time, unable to read.	3
6.	Driving is dangerous.	2
7.	Prefer rail travel.	2
8.	Freeways, streets, signs need improving.	2

TABLE 4.9 (Cont'd)

2. Automobile (continued)

2.b. Unfavorable Comments

		Frequency
9.	Speed restrictions not enforced.	1
10.	Highways are polluted.	1
11.	Other drivers are discourteous.	1
	Total unfavorable comments	45

3. Rail

3.a. Favorable Comments

1.	Generally good, best method of travel.	3
2.	Fast.	2
3.	Better than driving.	2
4.	Safe.	1
5.	Passengers courteous.	1
	Total favorable comments	9

3.b. Unfavorable Comments

1.	Connecting bus services needed.	5
2.	Terminal remote from downtown.	4
3.	Slow at non-commute hours.	3
4.	Schedules badly planned.	3
5.	Cars need window shades, more toilets.	2
6.	Smokers objectionable.	1
7.	Railroads do not care about passenger service.	1
8.	No monthly tickets for rail travel or auto parking.	1
9.	No bus transfer tickets.	1
10.	Not enough expresses at commute times.	1
11.	Should have single fare.	1
12.	Strike prone.	1
13.	Poor ticket purchase service.	1
14.	Slow compared with air travel.	1
15.	Equipment old.	1
	Total unfavorable comments	27

4. Ferry

4.a. Favorable Comments

1.	A pleasant sightseeing trip. Enjoyable, fun, relaxing, aesthetic. General overall approval.	26

TABLE 4.9 (Cont'd)

4. Ferry (continued)

4.a. Favorable Comments (continued)

		Frequency
2.	Chance to meet people.	4
3.	Preferred to bus travel.	4
4.	Lots of fresh air.	3
5.	Food and drink available.	3
6.	Personnel courteous.	3
7.	Freedom of movement.	2
8.	Good bus connections.	1
9.	Considerate to cyclists.	1
	Total favorable comments	47

4.b. Unfavorable Comments

1.	Schedules inconvenient. Infrequent service.	19
2.	Not enough routes.	16
3.	Connecting bus services not available or badly scheduled.	7
4.	Parking and other services at terminals need improving.	4
5.	Crowded at commute times and in summer.	3
6.	Prefer bus when weather bad.	3
7.	Slow loading and unloading. Need more efficient ticket collection and loading and unloading from both sides.	3
8.	Lower deck noisy, unpleasant.	2
9.	Concession prices high, service poor, quality low.	2
10.	Slow.	2
11.	Boats need improving:	
	Lounge, plastic dome.	2
	Heating.	2
	Larger tables.	1
	Better lighting.	1
	Warmer colors.	1
	More comfortable seats.	1
12.	Journey time too short.	1
13.	Noisy children.	1
14.	Unable to transport car.	1
15.	No monthly tickets available.	1
16.	No student discount on fares.	1
	Total unfavorable comments	74

TABLE 4.9 (Cont'd)

5. Helicopter

5.a. Favorable comments	Frequency
1. Convenient.	3
2. Novel.	1
3. Better than driving.	1
Total favorable comments	5

5.b. Unfavorable comments	
1. Poor parking facilities at terminals.	2
2. Noisy, windy, cramped.	2
3. Baggage handling service unreliable.	2
4. Schedules badly planned.	1
Total unfavorable comments	7

6. Other Modes

6.a. BART	
1. Look forward to using.	17
2. Will use if not too expensive.	9
3. Should be extended.	8
4. Will need good connecting bus services.	5
5. May be less convenient than bus.	3
6. Fares should be kept low in order to increase demand.	1
7. Will prefer to drive.	1
Total comments	44

6.b. Cable Car	
1. Agreeable.	3
2. Crowded.	3
3. Should be retained.	2
4. Better than bus.	1
5. Unreliable.	1
Total comments	10

6.c. Cycle	
1. More safe cycle routes required.	6
2. More cycle parking needed.	5
3. Enjoyable.	2
Total comments	13

TABLE 4 .9 (Concluded)

6. Other Modes (continued)

	Frequency
6.d. Taxi	
1. Useful nights, Sundays, holidays, with luggage.	3
6.e. Air	
1. Fast	1
2. Crossing time zones objectionable.	1
3. Noisy.	1
4. Inadequate public transportation at airports.	1
Total comments	4
6.f. Walk	
1. Enjoy or prefer to walk.	6
2. Quicker, cheaper than bus.	2
3. Unsafe.	1
4. Unpleasant in bad weather.	1
Total comments	10
7. General Comments	
1. Public transportation system inadequate.	5
2. Need low-pollution travel.	4
3. Need low-cost travel.	4
4. Need or prefer high-speed travel.	4
5. One occupant cars should pay higher tolls.	3
6. All public transportation systems should be regionally coordinated.	3
7. Public transportation should be made more attractive and use encouraged.	2
8. Congestion should be reduced.	2
9. Remove hazardous drivers and vehicles from streets.	2
10. I pay $60 per month higher rent to minimize commute time.	1
11. Pollsters should ask more aesthetic-type questions.	1
12. More large employers out of city.	1
Total comments	32

TABLE 4.10

COMPARISON OF MODE USAGE WITH NUMBER OF COMMENTS MADE

Category	No. of Respondents using	No. of comments			No. of comments as percentage of No. of respondents using	
		Favorable	Unfavorable	Total	Favorable	Total
Bus	1230*	54	239	293	4.4	23.8
Auto	1034	74	45	119	7.2	11.5
Rail	244	9	27	36	3.7	14.7
Ferry	110	47	74	121	42.7	110.0
Helicopter	33	5	7	12		
Air	53	1	3	4		
Cycle	43	2	11	13		
Taxi	42	3	0	3		
Total	171	11	21	32	6.4	18.7
Cable Car		6	4	10		
BART				44		
Walk	1260	8	2	10		

* Includes cable car

4.6 MODE CHARACTERIZATION IN TERMS OF TRAVELER ATTITUDES

The rating survey form was designed with "commonality" in mind, that is to say that the rating scale verbal descriptors had to be generally applicable regardless of mode. Not all scales were successful in this sense and, in fact, some scales relate only to specific modes (for example, ratings on transit terminal characteristics). Due to this requirement, and also to the fact that up to four travel modes could be used in describing a trip, the data processing problem was exceedingly complex.

The first use of the data called for two basic sortings, 1) by mode, and 2) by number of modes used per trip. The results are shown in Table 4.3. The first sorting produced twelve data banks and the second produced four. In connection with the latter, a list of the most frequently used mode combinations as reported in the survey is presented in Table 4.11. Combinations represented in the sample fewer than ten times are not shown.

It was expected that some kind of annoyance factor might be derived as a function of number of modes used per trip. Accordingly, means and standard deviations for the twenty-five rating scales were calculated for each of the four trip combination data files and various plots were made. In no case did any consistent, clear-cut trend emerge and the analysis of these files was terminated. The means and standard deviations are summarized in Table 4.12. In passing, it should be noted that when all walk modes were deleted from these files, the number of single mode trips jumped from 440 to 900, two mode trips went from 402 up to 550, three mode trips dropped from 712 to 220, and four mode trips plummeted from 173 to 38.

Attention was next concentrated on the twelve so-called "modal files". Means and standard deviations were calculated and histograms plotted for each of the rating scales that were pertinent to each of the twelve individual modes. These statistics are summarized in Tables 4.13 and 4.14 together with the means and standard deviations for the entire usable sample of 1727 respondents. These statistics are adjusted for non-response which means that the average sample size varies from trip/vehicle characteristic to trip/vehicle characteristic as well as from modal file to modal file.

It is instructive at this point to recall that these averages are not directly comparable from characteristic to characteristic due to the fact that the integers on the rating scales are surrogates for verbal descriptors. For example, a rating of nine on Parking

TABLE 4.11

MODE COMBINATIONS LISTED
IN ORDER OF FREQUENCY OF USE

Combination	Frequency
Walk, bus, walk	220
Private car	211
Car, bus, walk	114
Bus	111
Walk, bus	81
Car, walk	69
Car pool	63
Car, bus	54
Drop off, bus, walk	43
Bus, walk	40
Car, rail, bus, walk	36
Car, rail, bus	28
Bus, bus	26
Car, rail, bus	22
Car, rail, walk	21
Walk, bus, bus, walk	20
Walk only	18
Car, ferry, walk	17
Drop off, bus	16
Car pool, walk	14
Car, car pool, walk	14
Walk, ferry, walk	14
Walk, bus, ferry, walk	13
Walk, bus, bus	13
Car, bus, ferry, walk	13
Car pool, bus, walk	12
Bus, bus, walk	12
Car, car pool	11
Drop off	10
Drop off, rail, bus, walk	10
Walk, rail or car	10

TABLE 4.12

TRIP/VEHICLE CHARACTERISTICS STATISTICS ACCORDING TO NUMBER OF MODES USED TO COMPLETE A TRIP

ITEM	N = 440 ONE-MODE		N = 402 TWO-MODE		N = 712 THREE-MODE		N = 173 FOUR-MODE	
	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
EN ROUTE TIME	5.936	1.997	5.591	1.678	5.781	1.825	5.44	1.853
WAITING TIME	7.289	2.200	6.823	1.940	6.866	2.125	6.696	1.988
SCHEDULE RELIABILITY	7.271	2.144	6.642	1.975	6.628	2.107	6.722	1.836
SEAT AVAILABILITY	7.590	2.376	7.245	2.061	6.899	2.439	6.855	1.993
ADEQUACY OF TRANSFERS	8.223	1.707	7.646	2.122	7.784	1.958	7.379	2.146
TERMINAL ACCESS	7.859	2.287	7.010	2.604	6.931	2.449	7.090	2.549
TRIP COST	5.472	1.912	4.893	1.654	5.186	1.681	4.982	1.561
METHOD OF PAYMENT	7.389	1.804	6.840	1.815	7.028	1.774	6.869	1.669
PARKING COSTS	6.359	2.991	7.345	2.443	6.593	2.702	7.409	2.267
SEAT COMFORT	6.593	2.126	5.310	1.761	5.778	1.975	5.494	1.525
VEHICLE SPACE	6.150	2.351	5.000	1.908	5.147	2.164	5.311	1.824
STORAGE SPACE	5.717	3.191	3.985	2.626	4.023	2.884	4.299	2.059
VEHICLE CLIMATE	6.123	2.281	5.108	2.073	5.587	2.175	5.716	1.716
SMOOTHNESS	5.910	2.243	4.848	1.937	5.085	2.096	5.253	1.755
PHYSICAL EFFECTS	7.546	1.847	6.756	2.076	7.035	1.963	6.975	1.926
NOISE LEVEL	5.955	2.238	5.043	1.691	5.336	2.028	5.453	1.632
TERMINAL CLIMATE	6.142	2.201	5.112	1.811	5.409	1.768	5.385	1.908
TERMINAL FACILITIES	5.434	2.589	4.228	1.915	4.660	1.892	4.364	2.158
SERVICE ASSISTANCE	4.619	2.875	5.002	2.376	5.172	2.470	5.730	2.406
ROUTE ALTERNATIVES	6.190	2.775	4.775	2.415	5.315	2.646	4.708	2.293
SECURITY	6.457	2.040	6.708	1.764	6.515	1.771	6.715	1.760
VEHICLE APPEAL	5.991	2.285	4.939	1.923	5.316	2.083	5.484	1.870
PRIVACY	5.621	3.305	3.752	2.228	3.882	2.818	4.700	2.354
USE OF TIME	4.440	2.736	4.991	2.315	4.516	2.526	5.067	2.235
OVERALL TRIP	6.204	2.085	5.039	1.887	5.366	1.944	5.036	1.988

TABLE 4.13

TRIP/VEHICLE CHARACTERISTIC STATISTICS ACCORDING TO MODE OF TRAVEL

	TRIP/VEHICLE CHARACTERISTIC	BUS/STREETCAR		RAIL		FERRY		HELICOPTER		HOUSEHOLD CAR		CAR POOL		TAXI	
		MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
1	EN ROUTE TIME	5.152	2.085	5.665	1.822	7.362	1.507	8.000	1.576	6.591	2.013	5.483	1.892	6.342	2.096
2	WAITING TIME	6.163	2.299	7.474	1.780	7.486	1.798	6.774	2.082						
3	SCHEDULE RELIABILITY	5.970	2.374	7.439	1.316	7.472	1.569	6.581	1.767						
4	SEAT AVAILABILITY	6.157	2.683	8.172	1.105	7.500	1.552	6.903	1.692						
5	ADEQUACY OF TRANSFERS	7.412	2.322	7.612	2.375	7.862	2.221								
6	TERMINAL ACCESS	6.658	2.867	7.577	2.209	7.821	2.233	4.935	2.628	7.585	2.346	7.821	2.329	8.000	1.944
7	TRIP COST	4.971	1.680	4.299	1.783	6.098	1.286	4.323	2.040	5.473	2.002	6.066	1.827	3.657	2.261
8	METHOD OF PAYMENT	6.437	1.984	7.460	1.583	7.190	1.813	6.032	1.573	7.732	1.684	8.035	1.556	7.172	1.627
9	PARKING COSTS	7.324	2.956	8.000	1.382	8.313	1.740			7.012	2.621	6.267	2.968		
10	SEAT COMFORT	4.103	1.895	6.004	1.738	5.717	1.835	5.032	1.077	7.745	1.527	6.926	1.752	6.029	1.723
11	VEHICLE SPACE	2.548	2.210	6.284	1.714	7.425	1.480	4.806	1.447	7.252	1.934	6.195	2.072	5.938	1.917
12	STORAGE SPACE	2.548	2.210	5.947	2.043	5.581	2.822	4.871	2.041	7.786	1.875	6.567	2.342	6.382	1.809
13	VEHICLE CLIMATE	4.554	2.068	6.529	1.778	6.764	1.654	5.258	1.383	7.235	1.910	6.556	1.868	6.118	1.788
14	SMOOTHNESS	4.109	1.963	5.449	2.053	6.848	1.586	5.484	2.064	7.020	1.725	6.556	1.490	5.406	1.643
15	PHYSICAL EFFECTS	6.308	2.225	7.513	1.782	8.157	1.398	7.581	2.157	8.329	1.218	7.761	1.512	8.176	1.732
16	NOISE LEVEL	4.569	1.822	5.635	1.905	5.848	1.930	2.613	1.720	7.177	1.880	6.659	1.623	5.812	1.712
17	TERMINAL CLIMATE	4.861	1.775	5.435	1.764	5.931	2.190	5.613	2.038						
18	TERMINAL FACILITIES	3.905	1.907	3.941	1.897	5.463	2.040	5.581	1.788						
19	SERVICE ASSISTANCE	4.604	2.492	5.526	2.257	7.703	1.752	7.194	1.542						
20	ROUTE ALTERNATIVES	4.770	2.463	4.422	2.167	5.733	2.569	6.000	2.358	5.334	2.630	5.525	2.632	5.132	2.601
21	SECURITY	6.230	1.998	7.397	1.620	8.307	1.155	6.774	1.807	7.044	1.813	6.555	2.031	6.029	1.899
22	VEHICLE APPEAL	4.314	1.963	5.749	1.843	7.117	1.517	5.484	1.730	7.132	1.916	7.073	1.649	5.151	1.938
23	PRIVACY	2.704	1.971	4.578	2.300	5.933	2.559	4.742	2.785	8.215	1.983	3.841	2.863	6.267	2.888
24	USE OF TIME	4.109	2.469	6.943	2.105	7.381	1.997	3.419	2.539	3.730	2.889	4.156	2.649	3.821	2.695
25	OVERALL TRIP	4.726	1.810	4.876	1.769	7.179	1.602	6.581	1.432	5.673	1.987	6.040	1.969	5.625	1.917

TABLE 4.14

TRIP/VEHICLE CHARACTERISTICS STATISTICS ACCORDING TO MODE OF TRAVEL

	TRIP/VEHICLE CHARACTERISTIC	AIR		CYCLE		FAMILY DROP-OFF		INITIAL WALK		FINAL WALK		TOTAL SAMPLE	
		MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
1	EN ROUTE TIME	6.755	1.640	7.140	1.872	7.346	1.667	7.493	1.802	7.196	2.038	5.707	1.821
2	WAITING TIME	6.240	1.954									6.934	2.062
3	SCHEDULE RELIABILITY	6.653	1.575									6.781	2.047
4	SEAT AVAILABILITY	7.783	1.480									7.195	2.229
5	ADEQUACY OF TRANSFERS	7.409	1.957									7.744	2.030
6	TERMINAL ACCESS	5.343	3.019									7.153	2.529
7	TRIP COST	4.958	2.03[illegible]	8.118	1.887							5.117	1.734
8	METHOD OF PAYMENT	8.000	1.277									7.016	1.600
9	PARKING COSTS	4.444	2.877									6.878	2.700
10	SEAT COMFORT	5.913	1.589	5.333	2.665							5.738	1.946
11	VEHICLE SPACE	5.447	1.348									5.337	2.121
12	STORAGE SPACE	5.178	1.874	3.310	2.647							4.438	2.873
13	VEHICLE CLIMATE	6.808	1.469									5.524	2.153
14	SMOOTHNESS	6.478	1.378	4.621	2.259							5.190	2.075
15	PHYSICAL EFFECTS	7.783	1.548	7.839	1.791							7.036	2.003
16	NOISE LEVEL	5.689	1.781	6.667	2.952							5.374	1.942
17	TERMINAL CLIMATE	6.595	1.822									5.333	1.889
18	TERMINAL FACILITIES	5.857	2.043									4.449	2.051
19	SERVICE ASSISTANCE	7.046	2.023									5.089	2.482
20	ROUTE ALTERNATIVES	5.714	2.372	5.116	2.509	4.951	2.472	5.014	2.514	4.888	2.501	5.201	2.599
21	SECURITY	7.422	1.357	5.967	2.580	7.677	1.708	7.220	2.110	7.368	1.898	6.602	1.838
22	VEHICLE APPEAL	6.667	1.773									5.330	2.084
23	PRIVACY	4.000	2.291									4.312	2.773
24	USE OF TIME	5.957	2.032	3.714	3.101	4.769	3.295	4.640	2.841	3.976	2.796	4.758	2.473
25	OVERALL TRIP	5.941	1.406	6.273	2.336	5.290	1.883	5.120	2.007	5.141	1.956	5.401	2.016

Costs really means "free parking" whereas a nine rating on Physical Side Effects is equivalent to "trip never causes physical discomfort". The really meaningful comparison is, then, across modal files and inspection of the tables shows considerable variation.

Of particular interest is the Enroute Trip Time mean rating because it, as will be seen, plays such an important role in the insertion of attitudinal variables in the mode split model. It ranges from a value of eight, or "almost barely noticeable", on the helicopter to a value of 5.15 or just "tolerable" on the bus mode. A much more striking display of the relative ordering across the modes of these and all the other mean values has been constructed but is deferred to Section 4.8 in order to allow the subjectively extrapolated mean values for STOL to be included.

One other type of data file was constructed in order to investigate the possible influence of the geographic features of travel corridors on trip/vehicle characteristic ratings. This was of interest, of course, since ultimately a vector of attitudinal variable values would have to be associated with each specific travel corridor included in the mode split model. If significant differences between ratings on different corridors were directly due to such an influence, this goal would be frustrated severely, if not entirely unfeasible. However, the contrasts between corridors can only be made, at least with this survey data, in terms of contrasts between modes, each of which operates in a pair of corridors. This implies a confounding between mode and corridor so that no clear-cut conclusion can be arrived at.

Despite this problem, contrasts were made between auto ratings on three principal corridors and also between bus ratings. A contrast is defined as a test of the hypothesis that there is no difference between the mean ratings of a characteristic of a particular mode from different corridors. For example, the hypothesis that the mean rating for "Waiting Time" for the bus mode on the Golden Gate corridor is equal to the similar mean on the Bay Bridge corridor is tested. This can be expressed simply by the form:

$$H: (\mu_1 - \mu_2) = 0.$$

A special version of analysis of variance was used to test all possible contrasts among the three corridors.* The results are shown in Tables 4.15 (a), (b), (c) for the bus mode and in Tables 4.16 (a), (b), (c) for the auto mode. The statistical tests were made at

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* The three corridors; viz., Golden Gate, Bay Bridge, and Peninsula, are defined in Section 4.9.

TABLE 4.15a

BUS CONTRASTS

Peninsula versus Golden Gate

Peninsula better than Golden Gate	Peninsula same as Golden Gate	Golden Gate better than Peninsula
Trip cost	Enroute time	Seat availability
	Waiting time	Storage space
	Schedule reliability	Security
	Adequacy of transfer	Use of time
	Terminal access	
	Method of payment	
	Seat comfort	
	Vehicle space	
	Vehicle climate	
	Smoothness	
	Physical effects	
	Noise level	
	Terminal climate	
	Terminal facilities	
	Service assistance	
	Vehicle appeal	
	Privacy	
	Route alternatives	
	Overall trip	

TABLE 4.15b

BUS CONTRASTS

Peninsula versus Bay Bridge

Peninsula better than Bay Bridge	Peninsula same as Bay Bridge	Bay Bridge better than Peninsula
None	Waiting time	Enroute time
	Terminal access	Schedule reliability
	Trip cost	Seat availability
	Method of payment	Adequacy of transfers
	Service assistance	Seat comfort
	Privacy	Vehicle space
	Route alternatives	Storage space
		Vehicle climate
		Smoothness
		Physical effects
		Noise level
		Terminal climate
		Terminal facilities
		Security
		Vehicle appeal
		Use of time
		Overall trip

TABLE 4.15c

BUS CONTRASTS

Golden Gate versus Bay Bridge

Golden Gate better than Bay Bridge	Golden Gate same as Bay Bridge	Bay Bridge better than Golden Gate
None	Waiting time	Enroute time
	Adequacy of transfers	Schedule reliability
	Trip cost	Seat availability
	Method of payment	Terminal access
	Storage space	Seat comfort
	Terminal climate	Vehicle space
	Service assistance	Vehicle climate
	Security	Smoothness
	Privacy	Physical effects
		Noise level
		Terminal facilities
		Vehicle appeal
		Use of time
		Route alternatives
		Overall trip

TABLE 4.16a

AUTO CONTRASTS

Golden Gate versus Peninsula

Golden Gate better than Peninsula	Golden Gate same as Peninsula	Peninsula better than Golden Gate
None	Enroute time	Route alternatives
	Trip cost	
	Method of payment	
	Seat comfort	
	Vehicle space	
	Storage space	
	Vehicle climate	
	Smoothness	
	Physical effects	
	Noise level	
	Security	
	Vehicle appeal	
	Privacy	
	Use of time	
	Overall trip	

TABLE 4.16b

AUTO CONTRASTS

Bay Bridge versus Golden Gate

Bay Bridge better than Golden Gate	Bay Bridge same as Golden Gate	Golden Gate better than Bay Bridge
Trip cost	Enroute time	None
	Method of payment	
	Seat comfort	
	Vehicle space	
	Storage space	
	Vehicle climate	
	Smoothness	
	Physical effects	
	Noise level	
	Security	
	Vehicle appeal	
	Privacy	
	Use of time	
	Route alternatives	
	Overall trip	

TABLE 4.16c

AUTO CONTRASTS

Bay Bridge versus Peninsula

Bay Bridge better than Peninsula	Bay Bridge same as Peninsula	Peninsula better than Bay Bridge
Enroute Time	Method of payment	None
Trip cost	Seat comfort	
	Vehicle space	
	Storage space	
	Vehicle climate	
	Smoothness	
	Physical effects	
	Noise level	
	Security	
	Vehicle appeal	
	Privacy	
	Use of time	
	Route alternatives	
	Overall trip	

the 5% significance level. If the hypothesis of no difference was accepted, the name of the characteristic was placed in the center column of the appropriate table. If it was rejected, the characteristic was listed in the left column if μ_1 was greater than μ_2, and in the right column, otherwise.

The contrast tables for auto show that there are, for all practical purposes, no significantly important differences that would suggest substantial bias due to geography. On the other hand the contrasts for the bus mode show distinct differences. It is known, however, that bus service on the Golden Gate and Peninsula corridors is provided primarily by Greyhound, whereas both A/C Transit and Greyhound provide service on the Bay Bridge route. There is ample evidence in the open-end comments that A/C Transit is highly regarded by commuters. The decided contrast between Bay Bridge corridor and the two others with respect to travel by bus is ascribed to differences in service provided and equipment used rather than to the geographic nature of the corridors. Consequently, for want of further evidence to the contrary, corridor geography will be considered to have negligible impact on ratings.

4.7 PREDICTION OF OVERALL TRIP RATING

One of the most interesting speculations about investigations involving trip rating scales is that an Overall Trip Rating (OTR) can be expressed as a function of ratings of trip/vehicle characteristics. This speculation has proved true in prior investigations made by participants in this study. There is also reason to believe that the OTR can be expressed in terms of a time penalty or a cost penalty, or both. A time penalty is defined as the amount of time a commuter would be willing to adjust his schedule in order to continue to use a presently favored mode. Alternatively, it is the amount of time use of an alternative mode must save him in order to cause him to switch modes. A cost penalty is defined as the premium over present cost that a commuter would pay in order to continue on a presently favored mode (as compared to alternatives). It also can be viewed as the minimum reduction of cost that a less favored alternative would have to offer in order for a commuter to switch.

The problem of developing regression models for OTR is made more difficult in the present study due to the possibility of more than one mode being used to complete a trip. The approach taken here was to separate respondents into unique sets such that a respondent was claimed be in the set of his "predominant" mode. This was accomplished in the following way. If a person used both ferry and bus he was considered a ferry passenger and his OTR was viewed as principally a

function of the ferry trip characteristics. All persons using train (but not ferry) were put in the train group. All persons using bus (but not train or ferry) went into the bus group. Finally all respondents using auto (but not bus, train or ferry) were placed in the auto group. Carpoolers constitute a ready-made group.

The OTR was fit for each mode as a function of fourteen characteristics that were mutually compatible across modes. The model was a simple linear combination such as has proved best in prior experiments in aircraft preference.

The model

$$\text{O.T.R.} = k + \sum_{i=1}^{14} \beta_i \, r_i$$

where

O.T.R. = Overall Trip Rating

k = Constant

r_i = Rating for i^{th} characteristic

β_i = Regression coefficient to be estimated

was fit by the stepwise least square algorithm to each of the five "mutually exclusive" modal files and the results are summarized in Table 4.17. Each column represents a regression. The attitudinal variables are shown at the left. The various estimates for their coefficients are listed in the regression columns together with the corresponding Student's t value in parentheses. An asterisk denotes that the variable in the corresponding row is not significant (at 5% level) in the fit to the modal O.T.R. of the corresponding column.

Values of the standard indicators of goodness of fit are grouped in the lower portion of the columns. These indicators are S.E., the standard error of the estimate, and r, the multiple correlation coefficient. Also shown are two values for O.T.R. predicted by two different regression models. O.T.R.(1) was predicted by the fits shown in Table 4.17. O.T.R.(2) was predicted by a model fit (for the identical set of variables) to the total sample of 1727 respondents regardless of mode. The reason for this comparison will be explained subsequently. For the moment an examination of the variables that turned out to be significant explicators of O.T.R. for the various modes is of interest.

TABLE 4.17

SUMMARY OF REGRESSION MODELS FOR THE PRINCIPAL MODES

Item No.	Item	MODE				
		Auto	Car Pool	Bus	Train	Ferry
	Constant	0.10360	1.31753	.47597	-.70390	.73053
1	Time	*	*	.17121 (7.06)	.27993 (4.57)	*
2	Cost	*	*	*	.14198 (2.42)	*
3	Seat Comfort	*	.42654 (4.62)	.08740 (2.62)	.18126 (2.68)	*
4	Spaciousness	*	*	*	*	.28489 (2.76)
5	Storage Space	*	*	*	*	*
6	Climate	*	*	.12118 (4.24)	*	*
7	Smoothness	*	*	.05701 (1.76)	*	.32912 (3.06)
8	Physical effects	.28880 (3.9)	*	*	*	*
9	Noise	*	*	*	*	.16886 (1.95)
10	Safety	.13740 (2.5)	*	.06013 (2.26)	.17623 (2.48)	*
11	Appeal	*	*	.12556 (3.94)	*	*
12	Privacy	*	*	*	*	*
13	Use of time	*	.11331 (1.84)	.11421 (5.54)	*	*
14	Alternates	.42045 (11.8)	.27205 (4.57)	.16646 (8.63)	.23681 (4.93)	.16807 (2.92)
	S.E.	1.6368	1.4063	1.2564	1.3408	1.2203
	r	0.6161	0.6952	.7074	.6791	.6748
	O.T.R. (1)	5.781	6.278	4.733	4.893	7.065
	O.T.R. (2)	6.784	6.178	4.737	5.736	7.201

First of all, notice that the public modes require more explicators than do auto or car pool. The bus, apparently the least popular mode, requires the most. The feeling about time spent enroute is significant only for bus and train. Most interesting of all, train is the only mode for which trip cost rating is important. This apparent insensitivity to cost will be buttressed by further evidence throughout this report.

All modes are sensitive to route alternatives; the signs on the coefficients are correct, and coefficient magnitudes appear to be appropriate. The S.E. is rather large in every case, but this is a reflection of the large scatter in the data. The fits are considered good, however, because there is a definite linear mean tendency in the data, despite the scatter. It is of no interest to fit each and every point, but only to define mean trends.

Returning to the reasons for comparison between O.T.R.(1) and O.T.R.(2), it can be seen that the two values are very close for bus, ferry, and car pool, but not so good for train and for auto. One wonders what the comparison would be like if ratings on STOL were available. In fact, the purpose for these comparisons is to determine how well a model that is fitted to the entire sample does in predicting on the individual modal subsets resident in the total sample. If the subsets are fit fairly well, then one could feel reasonably secure in using the total sample model to predict STOL. That is precisely what has been done here.

Since the public modes dominate the sample, one would not expect as good a fit to auto as to the other modes. Even car pool is public in the sense of sharing a vehicle at reduced expense and reduced personal aggravation.

The model obtained by fitting the entire sample was

O.T.R. = (Constant = -1.740)

+ 0.297 (Enroute Time Rating) + 0.148 (Trip Cost Rating)

+ 0.065 (Seat Comfort Rating) + 0.063 (Spaciousness Rating)

+ 0.012 (Storage Rating) + 0.075 (Climate Rating)

+ 0.068 (Smoothness Rating) + 0.044 (Physical Side Effects Rating)

+ 0.080 (Noise Rating) + 0.087 (Safety Rating)

+ 0.145 (Appeal Rating) + 0.031 (Privacy Rating)

+ 0.107 (Use of Time Rating) + 0.079 (Route Alternative Rating)

The multiple correlation coefficient, r = 0.832 and S.E. = 1.11.

The O.T.R.(2) predictions for a particular mode were obtained by inserting the mean rating for the fourteen characteristics on that mode in the equation above.

An indication of how much a commuter values the particular principal mode of travel he customarily uses can be obtained by a perusal of Figure 4.8. For example, 50% of ferry customers are willing to adjust their present schedule by twenty-two minutes or more while only 23% of auto users and only 20% of bus and train users would do the same. The rise in penalty time as a function of mean overall trip satisfaction is apparent in Figure 4.9. Similar tendencies with respect to cost penalty are apparent in Figures 4.10 and 4.11, although it is evident that there is not so wide a spread between the modal penalty cost functions as there is between the modal penalty time functions.

In Figures 4.12 and 4.13, the percent willing to self-impose either a time penalty of whatever length or a cost penalty of whatever cost is plotted against overall trip rating. These two functions can be used to obtain a crude but quite reasonable estimate of proportion of modal traffic that would divert to a new mode (such as STOL).

Suppose it were possible to estimate an average overall trip rating for a mode not presently available in the San Francisco intraurban area. Suppose, precisely, the mean value was 5.5. Entering the plots at that abscissa, one finds that 18% of auto commuters would not adjust schedule; that is, 18% of those whose satisfaction level is 5.5 do not value their present mode over alternative modes. Given the same satisfaction level of 5.5, half of the 18% could be expected to stay with the auto and half divert to the new mode.

From the cost penalty function in Figure 4.13 about 36% of auto users (at 5.5) are indifferent to their present mode from a cost point of view. Therefore, half could be expected to divert to a new mode offering the same overall satisfaction level.

In the language of probability, the proportion of commuters that could be expected to divert from a specified mode is given by the union of the two (not necessarily independent) events of the likelihood of time diversion (T) and the likelihood of cost diversion (C), symbolically,

$$P(T \cup C) = P(T) + P(C) - P(TC)$$

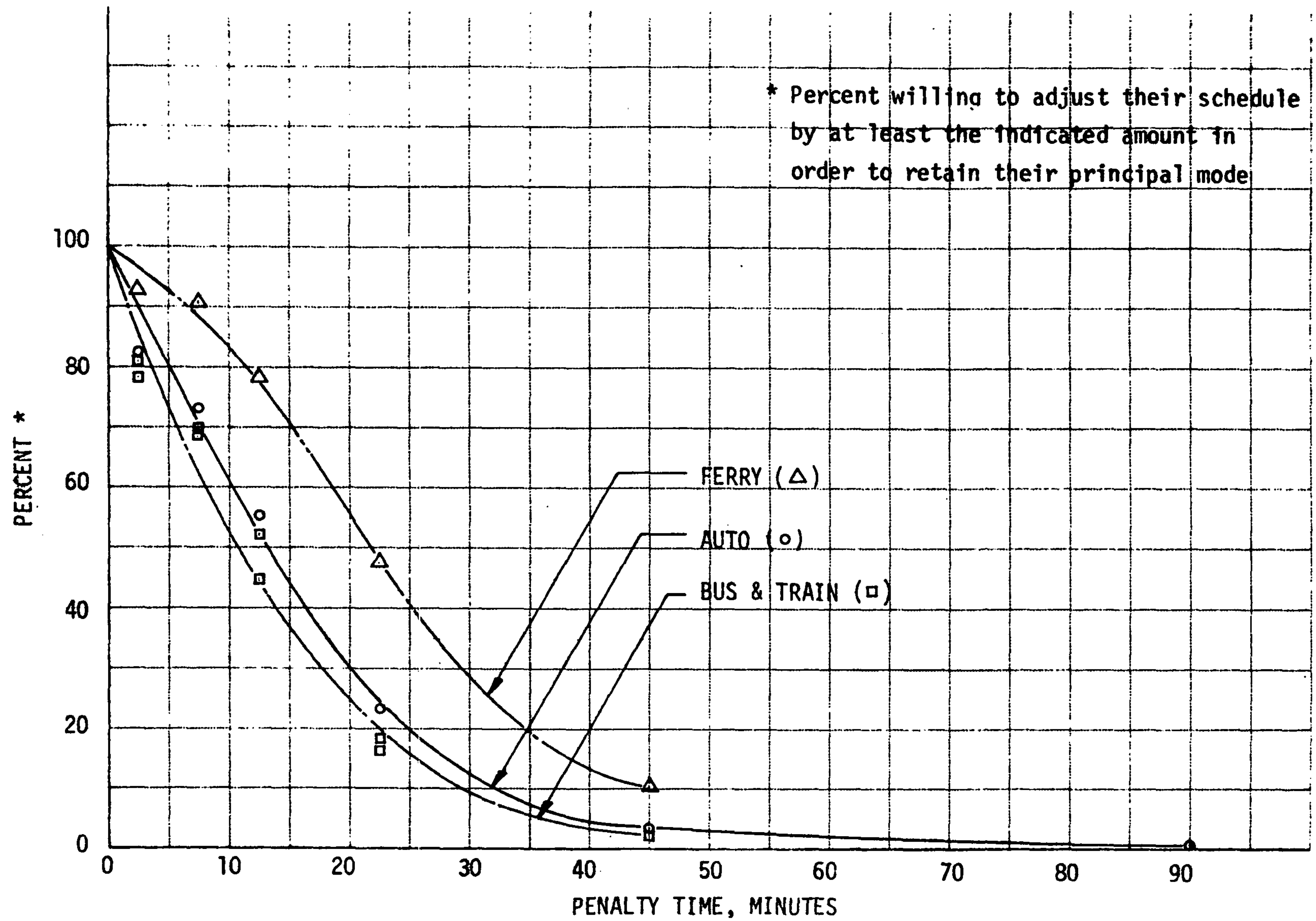

Figure 4.8 Schedule Penalty Time

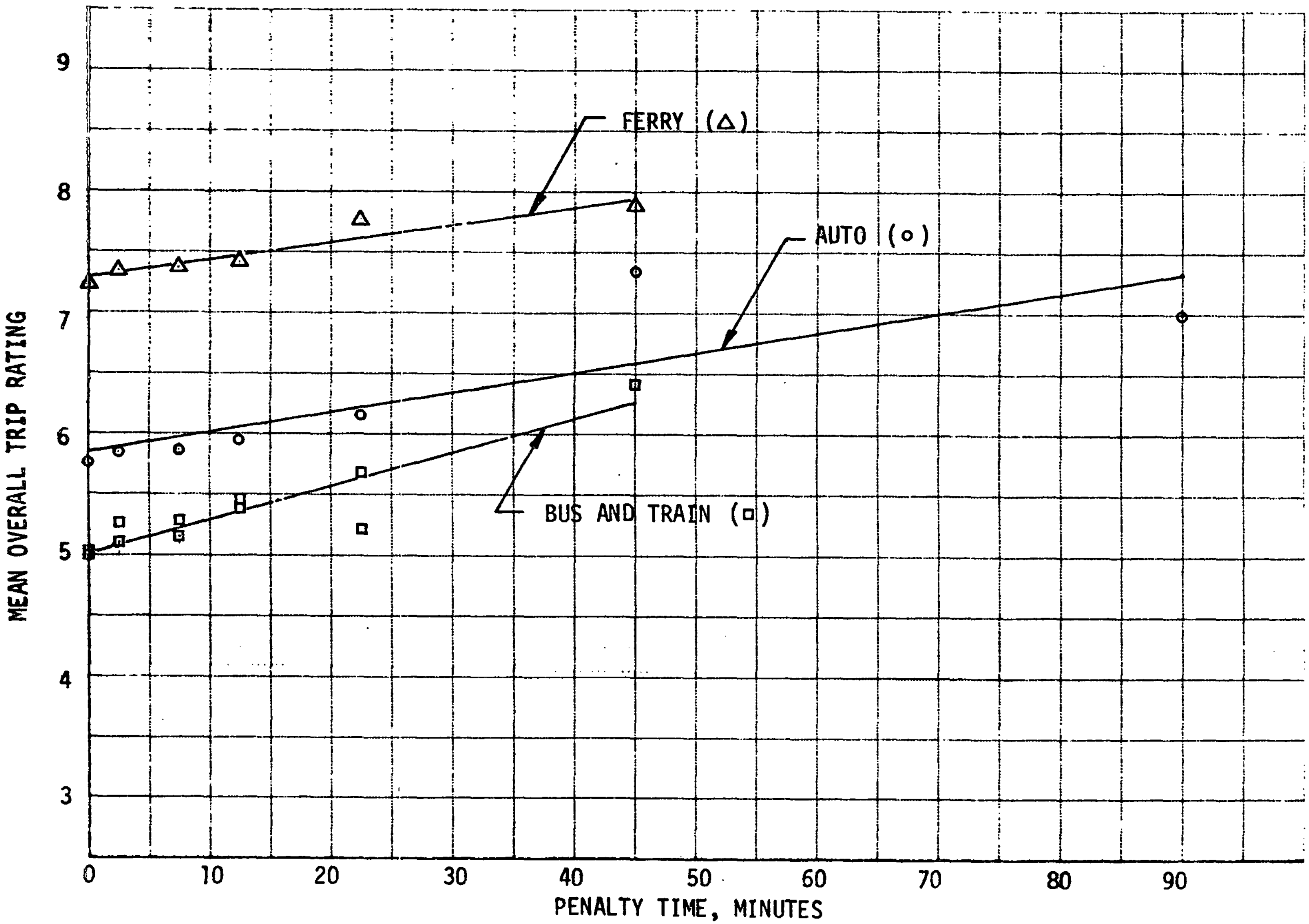

Figure 4.9 Variation in Mean Overall Trip Rating with Penalty Time

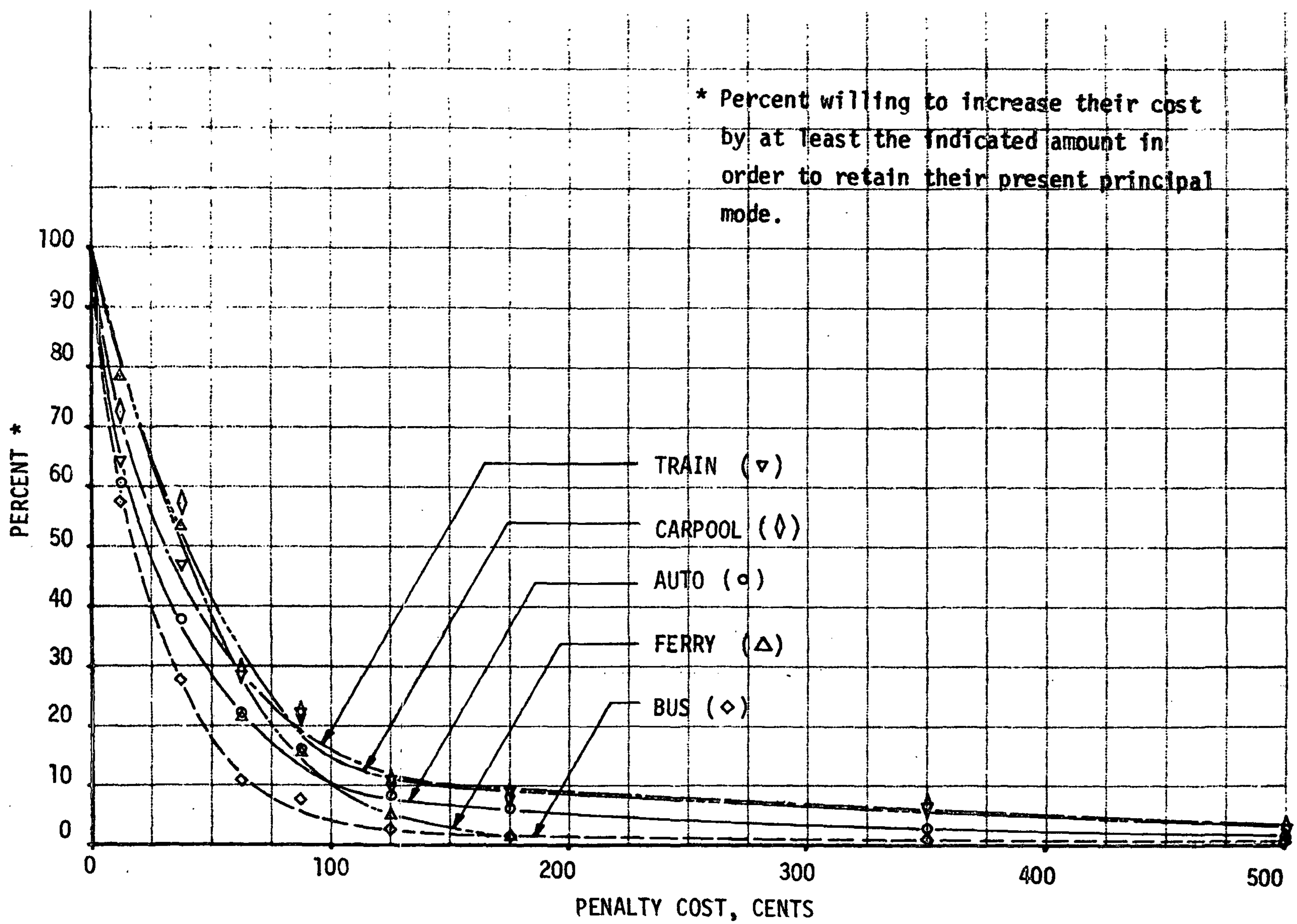

Figure 4.10 Trip Penalty Cost

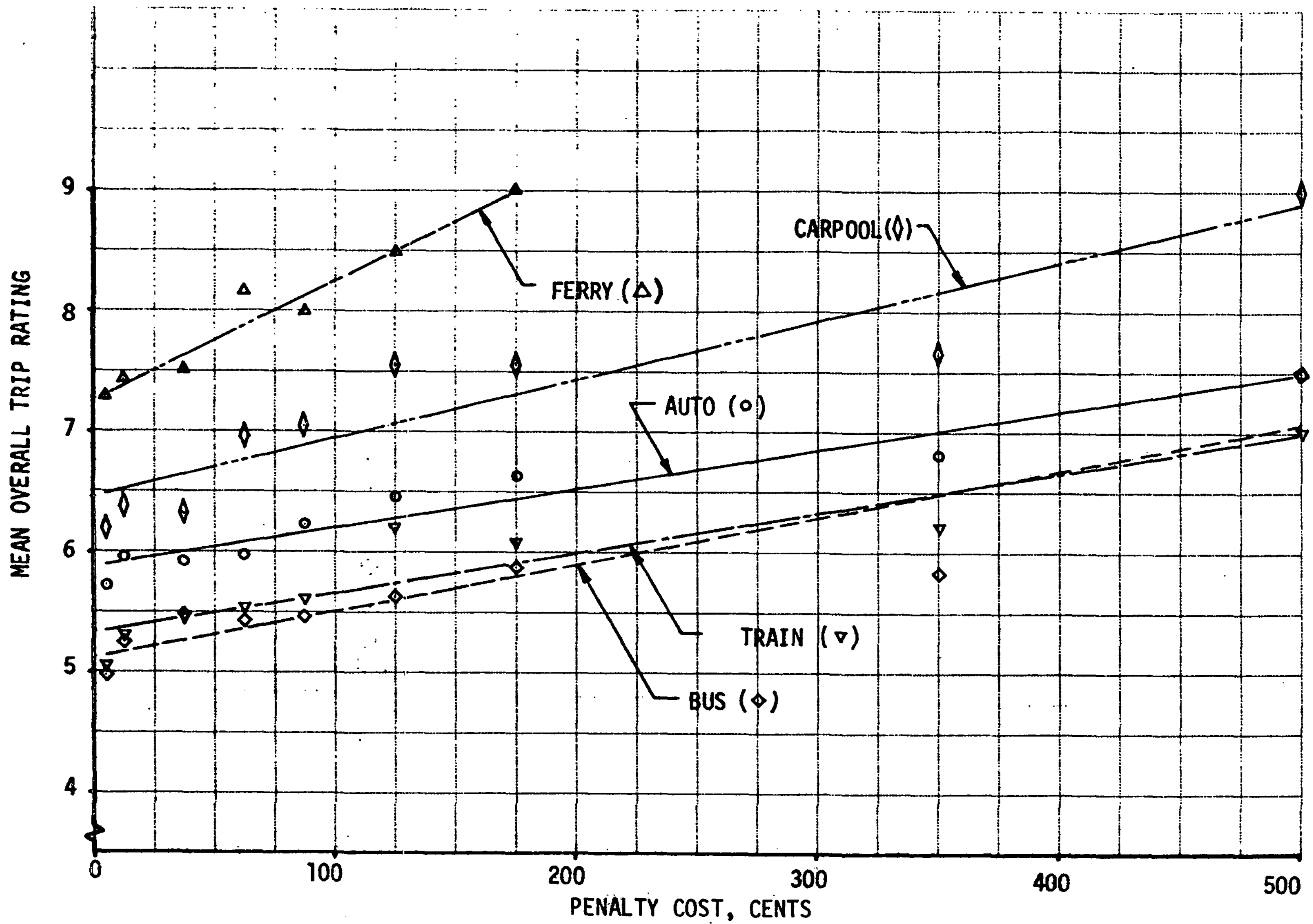

Figure 4.11 Variation of Mean Overall Trip Rating with Penalty Cost

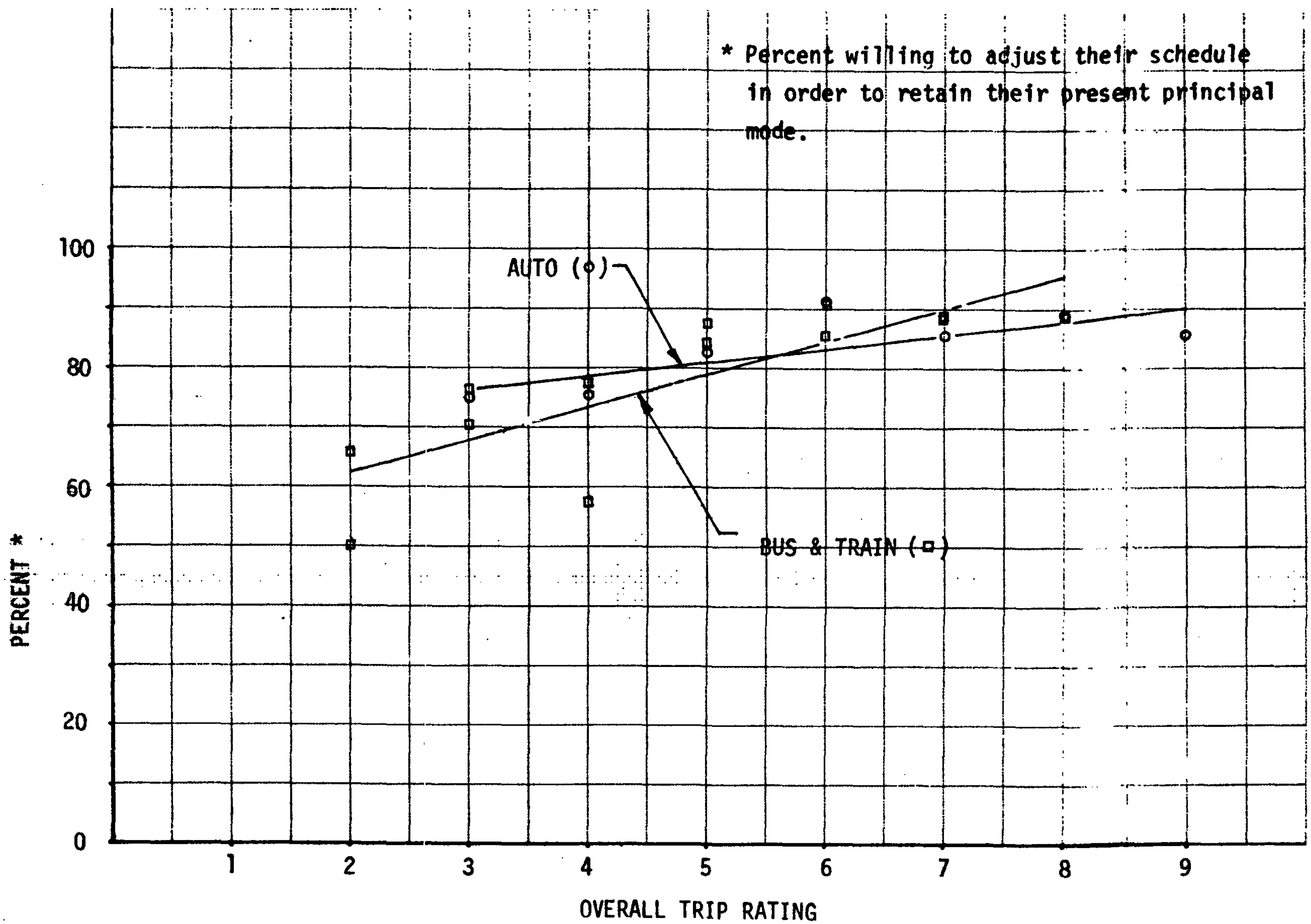

Figure 4.12 Penalty Time Diversion Function

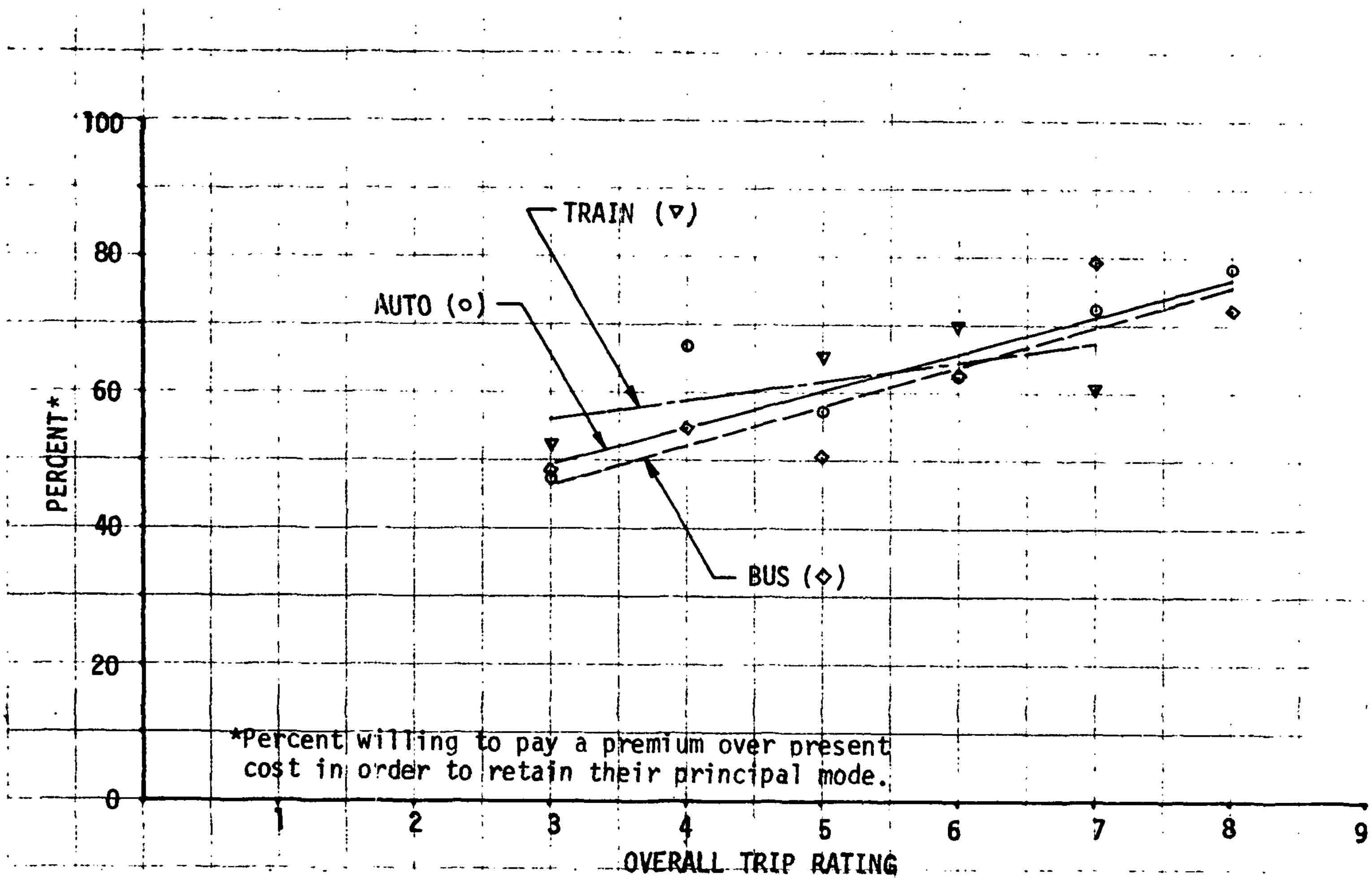

Figure 4.13 Penalty Cost Diversion Function

In our example we have

$$P(T) = .09$$

$$P(C) = .18$$

$$P(TC) = .0162$$

Therefore, the proportion of auto commuters that could be expected to divert to an equally attractive mode with satisfaction level of 5.5 is

$$P(T \cup C) = .25$$

The reasonableness of the estimate is tempered, of course, by the interaction of the modes involved with range in miles.

4.8 STOL EXTRAPOLATION

In Section 4.6, means and standard deviations of ratings of trip/vehicle characteristics were presented in tabular form. A more striking method of presentation of the mean ratings is to construct rating totems for each mode such as in Figures 4.14 through 4.16. With these displays one can obtain at a glance a measure of how convenience factors, service factors, and vehicle characteristics group within a mode. Modal comparisons are immediate.

Estimates of mean ratings for a STOL totem were determined by subjectively comparing what is known about proposed STOL vehicles and their in-service characteristics with the mean ratings obtained by the survey for all the existing modes in the San Francisco intraurban area. A very conservative rating of 2 was assigned to trip cost rating which would make STOL worst with respect to cost attitudes. The values so assigned to the fourteen characteristics that were used in the total sample regression model of Section 4.7 were inserted in that model and an overall trip rating for STOL of 5.75 was predicted.

A convenient way to compare ratings between modes for a specific characteristic is provided by Figures 4.17 through 4.19. Here trip/vehicle characteristics are grouped again into the Vehicle Characteristics, Service Factors, and Convenience Factors categories. Clearly, if our subjective judgments are good ones, STOL competes very favorably on every characteristic except Trip Cost (which was given a deliberately conservative rating) and ranks equally with auto for overall trip rating.

Using auto as a base mode, a comparison between the five principal existing commuting modes and the extrapolated STOL mode is presented in Figure 4.20 in terms of the mean overall trip rating, the mean enroute time, and the mean trip cost rating. The ferry mode is superior to all. The bus and rail are entirely inferior to auto and the carpool mode would excel private autos except for the time rating. STOL appears to be in an excellent position, as far as attitudes are concerned, except for cost. A value of four was used in the calculation of STOL overall trip rating in order to suit the requirements of the plotting scale. However, it is obvious that the overall rating obtained in the regression extrapolation with a cost rating of two is still superior to that for auto.

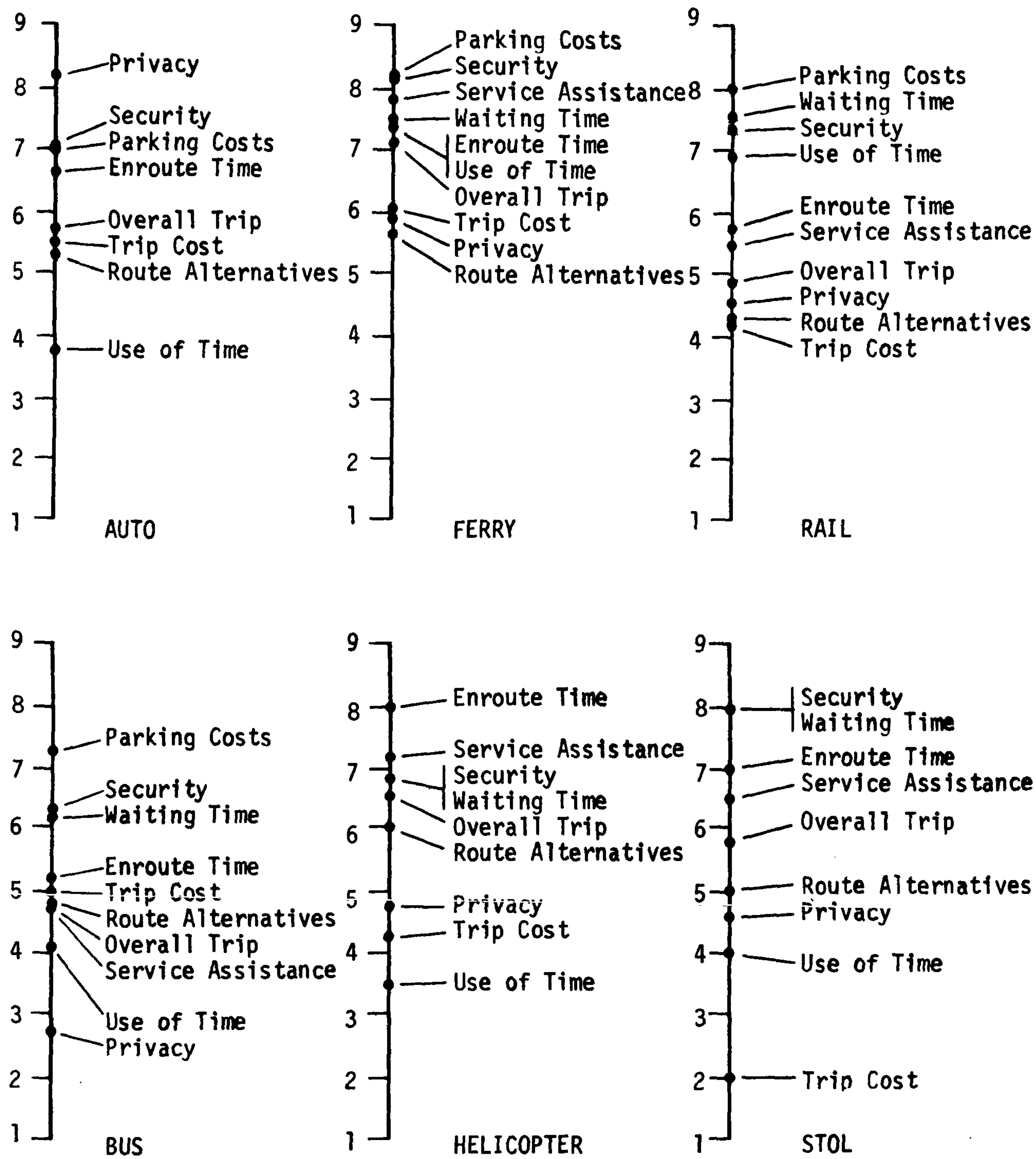

Figure 4.14

Modal Rating Totems for Service Factors

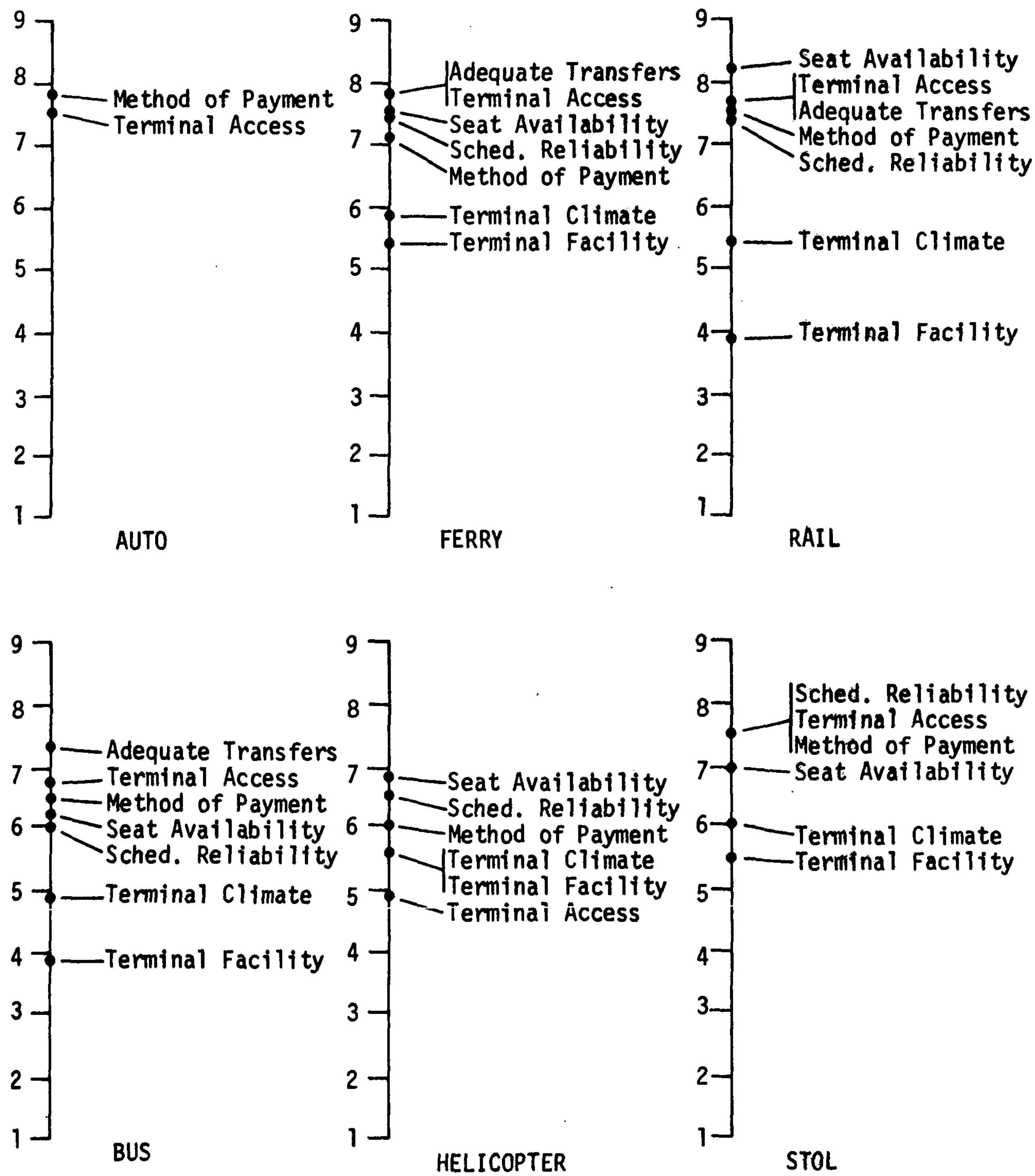

Figure 4.15

Modal Rating Totems for Convenience Factors

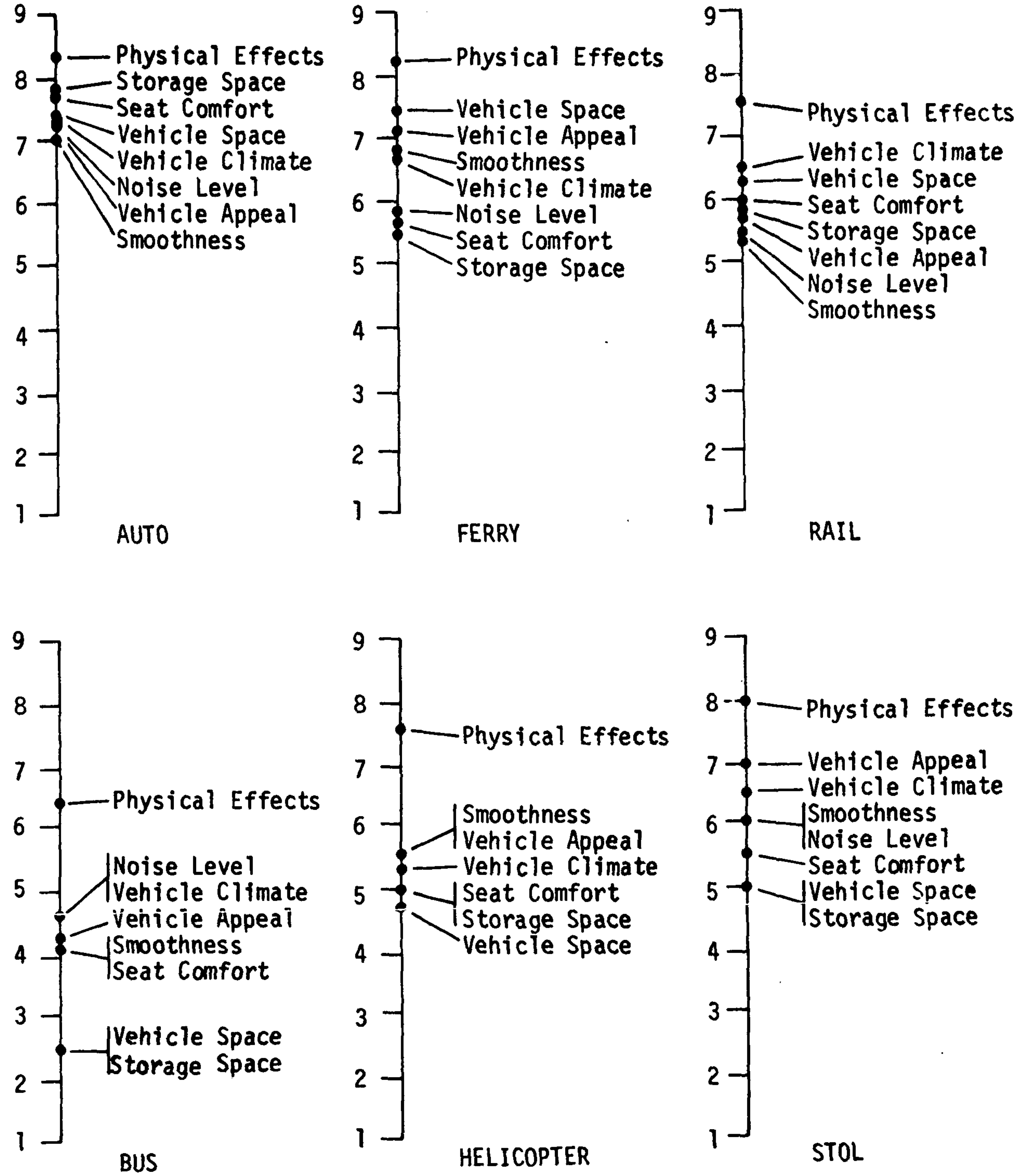

Figure 4.16

Modal Rating Totems for Vehicle Characteristics

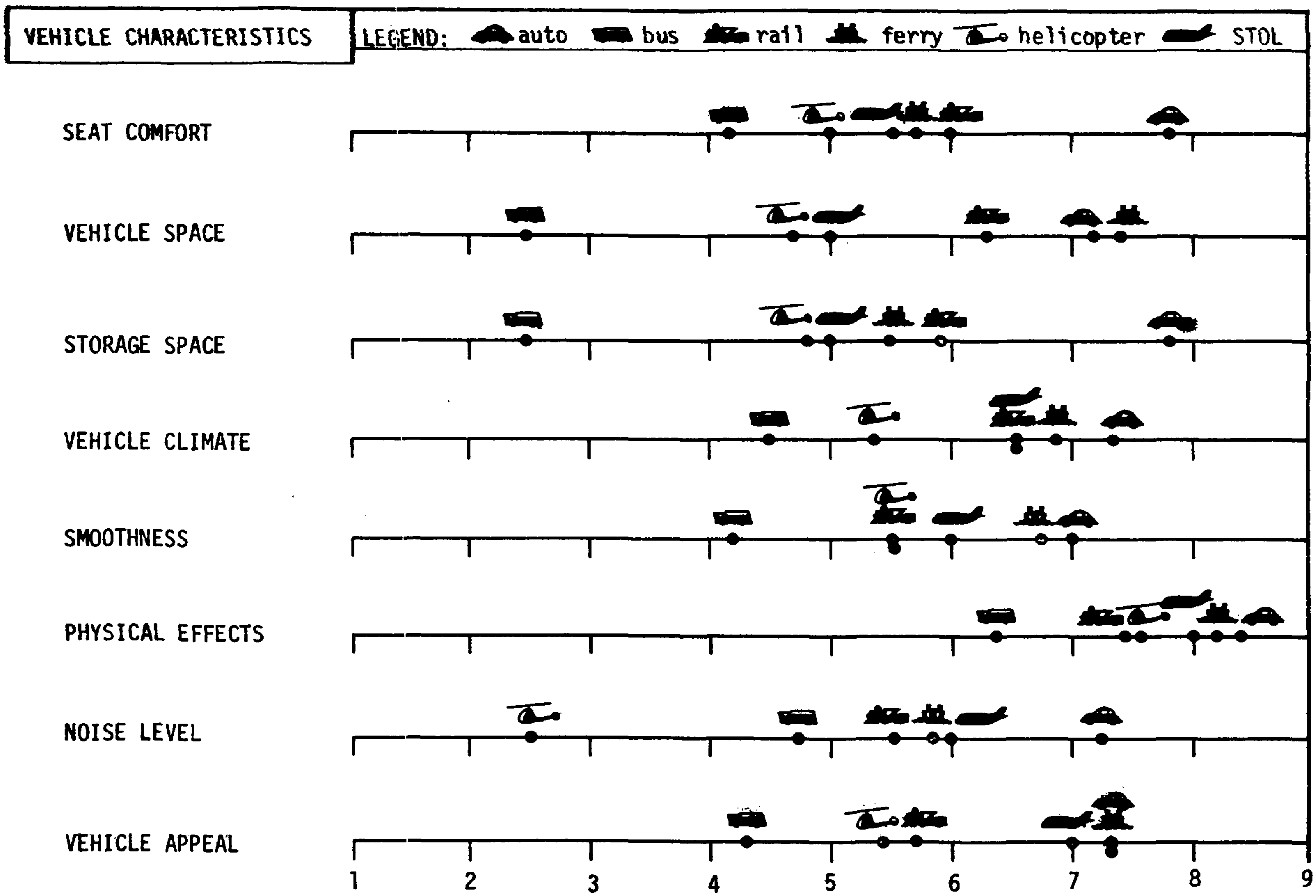

Figure 4.17

Mean Modal Rating Comparison for Vehicle Characteristics

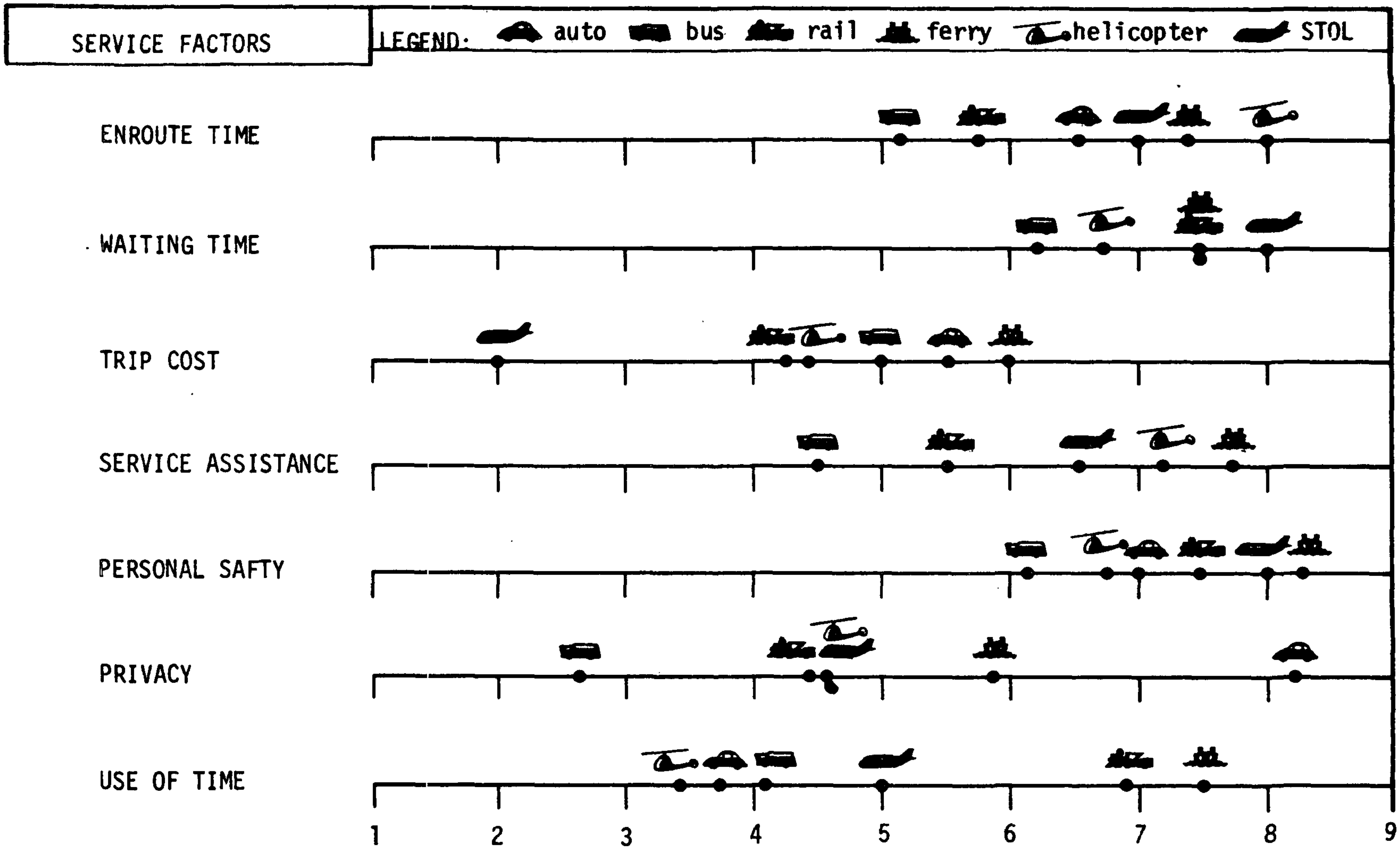

Figure 4.18

Mean Modal Rating Comparison for Service Factors

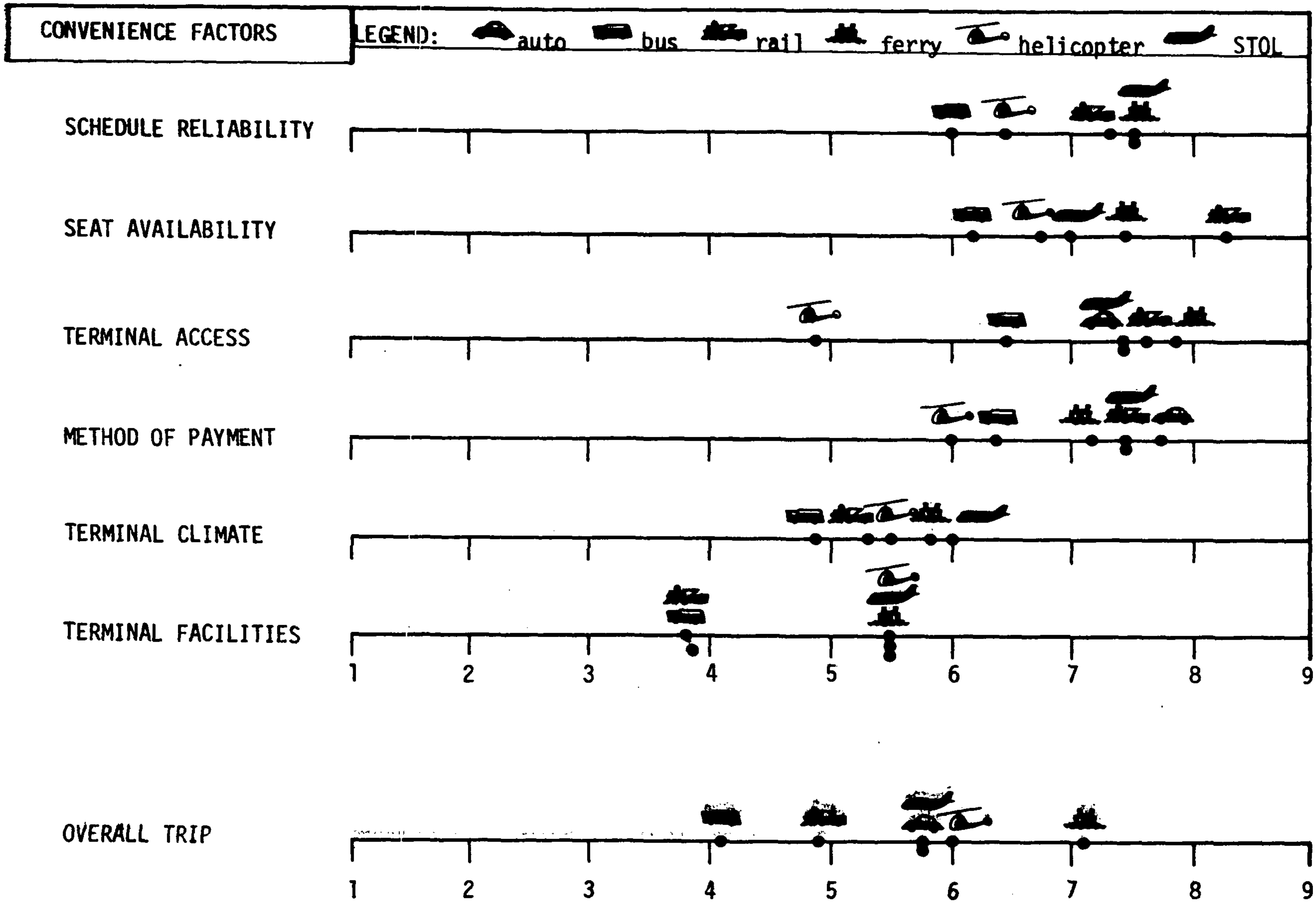

Figure 4.19

Mean Modal Rating Comparison for Convenience Factors

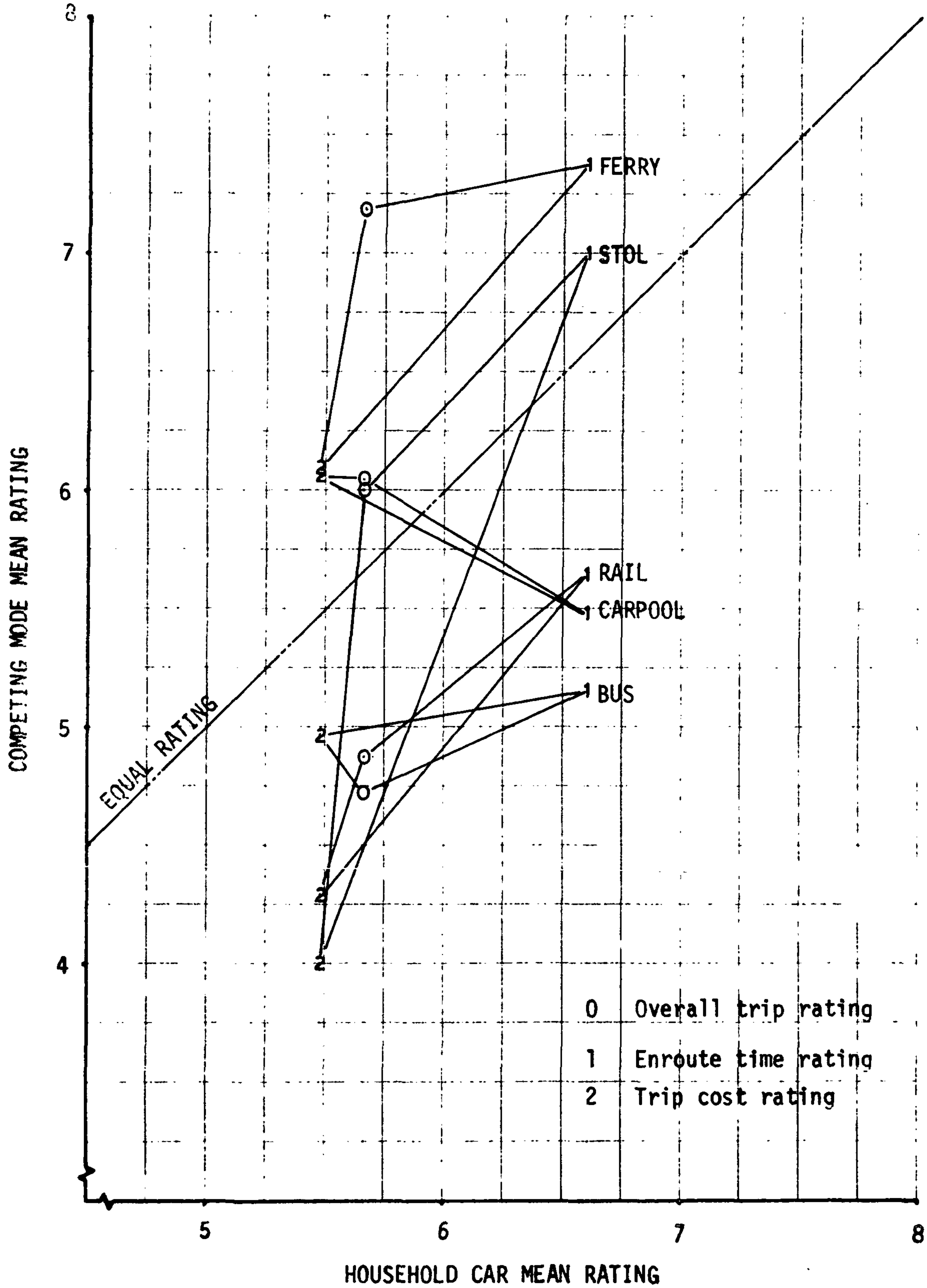

Figure 4.20

Modal Comparison with Auto Mode as Base

4.9 DISCRIMINANT ANALYSIS

An alternative approach was taken in the analysis of the survey results in an attempt to gain additional insight into the traveler's attitudes as a basis for predicting modal split. The approach used (and described in this section) involves developing linear functions of the attitudes and other response variables for each mode. The procedure will allot an individual to the mode which has the greatest function value for the individual's responses. If the discriminating power of the functions is high, a large proportion of the individuals will be allotted correctly. This type of analysis is called discriminant analysis.

This approach is potentially useful in the following ways:

1. It may be possible to forecast modal splits on the basis of attitudes.

2. It may be possible to design new vehicles on the basis of attitudinal information to influence modal choice.

3. Attitude information may be easier to collect and may be more reliable than information on such items as income, education, and personal property.

Sufficient data were available from the Northeast Corridor study to perform discriminant analysis for three city-pairs:

Washington, D. C. - Long Island
New York - Boston
Washington, D. C. - New York

Three modes of travel were involved: auto, air and bus. Data were available on the following five independent variables: income, actual or estimated trip cost, time on trip (length of stay), size of party on trip, and purpose of trip. The variation in estimated trip cost was extremely large, particularly for air and bus modes. In these two modes, the standard deviation was greater than the mean. Hence, in order to provide a better basis for comparison with the Bay Area investigation, these estimated trip costs were replaced with more realistic trip costs.

The results are shown in Table 4.18. Successful assignments by mode ranged from 69% to 81%. Bus travelers were assigned most successfully, with auto travelers a close second. In each corridor, the F statistic is highly significant, indicating a real difference among the modes sampled.

Discriminant analysis was also performed for the total San Francisco Bay Area and for three separate corridors in the Bay Area*:

Golden Gate (zones 29 and 30 to zones 1 and 2)
Oakland Bridge (zones 15 through 21 to zones 1 and 2)
Peninsula Route (zones 5 through 9 to zones 1 and 2)

Five modes of travel were involved: ferry, rail, bus, car and car pool.

Twenty-two variables of possible interest were chosen from the preference survey. They are listed below. Throughout the rest of this section, variables dealing with attitudes (variables 1, 2, 3, and 5 through 14 in the following list) will be called SOFT variables, and the other variables (variables 4 and 15 through 22) will be referred to as HARD (✓) variables.

No.		
1.	How do you feel about	En Route time.
2.	"	Waiting time.
3.	"	Trip Cost.
4.		✓ Estimate of trip cost.
5.	"	Convenience of method of payment.
6.	"	Seat comfort.
7.	"	Vehicle spaciousness and freedom of movement.
8.	"	Vehicle climatic condition.
9.	"	Smoothness of ride.
10.	"	Physical side effects.
11.	"	Personal safety and security.
12.	"	Vehicle appeal.
13.	"	Productive use of time.
14.	"	Overall opinion of mode combination used.
15.		✓ Purpose of trip.
16.		✓ How long away from home.
17.		✓ Sex.
18.		✓ Age.
19.		✓ Marital Status.
20.		✓ Education
21.		✓ Family income.
22.		✓ Autos in household.

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* A description of the construction of the 30 superzones used in this study can be found in Section 5.

TABLE 4.18

DISCRIMINANT ANALYSIS RESULTS FOR THE NORTHEAST CORRIDOR

City Pair	Approximate F	Sample Size	Mode	Bus	Air	Auto	Percent
D.C. L.I.	113.5 d.f. (10,1952)	240	Bus	193	34	13	80
		416	Air	121	289	6	69
		327	Auto	52	23	252	77
					Overall		75
N.Y. Boston	242.5 d.f. (10,3968)	344	Bus	270	64	10	78
		773	Air	148	617	8	80
		874	Auto	96	99	679	78
					Overall		79
D.C. N.Y.	286.5 d.f. (10,3012)	361	Bus	287	68	6	79
		769	Air	156	612	1	80
		383	Auto	36	38	309	81
					Overall		80

The modes from the survey were grouped and sorted in the following order:

1. Ferry
2. Rail
3. Bus
4. Car
5. Car Pool

If a person used more than one of the above modes during a specific trip he was placed only in the first mode in the above order. An example of this operation would be that if a person used both the ferry and bus he was considered a ferry passenger. This separation was done so that a person's attitude and demographic information would appear only once in the analysis.

The survey sample was constrained further in that each survey response was required to have entries for all of the 22 variables of interest.

Three separate investigations were performed, using the following data bases:

1. Total Bay Area
2. Three separate Bay Area corridors
3. Pooled corridors

The sample sizes for each investigation, by mode, are shown below:

		CORRIDOR			
MODE	TOTAL SURVEY AREA	GOLDEN GATE	EAST BAY OAKLAND BRIDGE	SAN FRANCISCO PENINSULA	POOLED CORRIDOR
Ferry	63	54			54
Rail	134			113	113
Bus	497	63	191	30	284
Car	106	10	11	13	34
Car Pool	34	14	11	4	29

Five separate analyses were done with the data from the total Bay Area sample, using different sets of independent variables. These sets were:

1. All 22 variables.
2. Thirteen soft variables.
3. Twelve soft variables (overall opinion of mode combination deleted).
4. Nine hard variables.
5. Best five variables from 22-variable analysis.

The results are shown in Table 4.19. The predictive quality of the soft variables is quite good. In fact, it is almost as good as that of the hard variables in the Northeast Corridor. Within the Bay Area, the soft variables perform much better than the hard variables.

It should be noted that the preference survey was not designed to collect hard data which might do a good job in predicting modal traffic. It was designed primarily to collect attitudinal data so that the value of attitudes in predicting modal split could be determined.

The corridor investigation included the Golden Gate route, Bay Bridge route, and the San Francisco Peninsula. For each route, five separate analyses were performed, as follows:

1. All 22 variables.
2. Twelve soft variables (overall opinion of mode combination deleted).
3. Nine hard variables.
4. Best five variables from 22-variable analysis.
5. Average best five variables over all three corridors (variable 6, 7, 11, 12 and 13.)

Table 4.20 shows the results for the Bay Bridge route (zones 15 through 21 to zones 1 and 2). Table 4.22 shows the results for the San Francisco Peninsula routes (zones 5 through 9 to zones 1 and 2). In all cases, the soft variables do a creditable job and outperform the hard variables.

The pooled corridor investigation uses combined data from the three separate corridors investigated above. For this investigation, only four different analyses were examined:

1. All 22 variables.
2. Twelve soft variables (overall opinion of mode combination deleted).
3. Nine hard variables.
4. Average best five variables (as above).

TABLE 4.19 DISCRIMINANT ANALYSIS RESULTS FOR THE TOTAL SURVEY AREA

	APPROXIMATE F	PREDICTIVE MATRIX						PERCENT CORRECT
			Ferry	Rail	Bus	Car	Car Pool	
All Variables	17.4 d.f. (88,3198)	Ferry	54	3	2	2	2	86
		Rail	6	100	16	2	10	75
		Bus	14	65	371	22	25	75
		Car	7	6	7	70	16	66
		Car Pool	0	3	2	8	21	62
		Total						74
13 Soft variables	25.6 d.f. (52,3166)	Ferry	52	3	2	3	3	83
		Rail	8	96	20	2	8	72
		Bus	26	65	355	30	21	71
		Car	8	5	8	63	22	59
		Car Pool	1	2	3	8	20	59
		Total						70
12 Soft variables	25.1 d.f. (48,3153)	Ferry	52	4	3	3	1	83
		Rail	11	89	20	4	10	66
		Bus	21	87	345	25	19	70
		Car	7	10	7	62	20	58
		Car Pool	2	3	3	8	18	53
		Total						68
9 Hard variables	6.1 d.f. (36,3078)	Ferry	29	9	10	6	9	46
		Rail	7	63	21	11	32	47
		Bus	44	91	180	57	125	36
		Car	25	12	17	24	28	23
		Car Pool	2	6	3	3	20	59
		Total						38
Best five from all variables	5.4 d.f. (20,2737)	Ferry	40	9	2	2	10	63
		Rail	12	90	22	3	7	67
		Bus	18	65	349	21	44	70
		Car	7	12	9	63	15	59
		Car Pool	2	6	4	10	12	35
		Total						66

TABLE 4.20 DISCRIMINANT ANALYSIS RESULTS FOR THE GOLDEN GATE ROUTE

	APPROXIMATE F		PREDICTIVE MATRIX Car	Bus	Car Pool	Ferry	PERCENT CORRECT
All variables	6.7 d.f. (66,347)	Car	7	0	1	2	70
		Bus	2	56	3	2	89
		Car Pool	1	0	13	0	93
		Ferry	0	2	1	51	94
		Total					90
12 Soft variables	9.9 d.f. (36,373)	Car	7	0	2	1	70
		Bus	4	56	2	1	89
		Car Pool	2	1	11	0	79
		Ferry	2	2	1	49	91
		Total					87
9 Hard variables	3.3 d.f. (27,377)	Car	6	3	0	1	60
		Bus	6	28	16	13	44
		Car Pool	0	4	9	1	64
		Ferry	0	13	5	36	67
		Total					56
5 Best variables	21.1 d.f. (15,368)	Car	6	0	2	2	60
		Bus	2	55	1	5	87
		Car Pool	1	1	8	4	57
		Ferry	0	3	7	44	82
		Total					80
Five Average best variables	19.8 d.f. (15,368	Car	8	0	0	2	80
		Bus	2	56	4	1	89
		Car Pool	4	0	8	2	57
		Ferry	2	3	5	44	82
		Total					82

TABLE 4.21 DISCRIMINANT ANALYSIS RESULTS FOR THE BAY BRIDGE ROUTE

	APPROXIMATE F		PREDICTIVE MATRIX Auto	Bus	Car Pool	PERCENT CORRECT
All variables	4.1 d.f. (44,378)	Auto	8	0	3	73
		Bus	3	172	16	90
		Car Pool	0	1	10	91
		Total				89
12 Soft variables	6.1 d.f. (24,398)	Auto	9	0	2	82
		Bus	6	168	17	88
		Car Pool	0	1	10	91
		Total				88
9 Hard variables	2.1 d.f. (18,404)	Auto	5	5	1	45
		Bus	7	126	58	66
		Car Pool	1	5	5	45
		Total				64
5 Best variables	12.1 d.f. (10,412)	Auto	5	0	6	45
		Bus	5	163	23	85
		Car Pool	2	2	7	64
		Total				82
5 Average best variables	10.6 d.f. (10,412)	Auto	8	0	3	73
		Bus	8	164	19	86
		Car Pool	2	2	7	82
		Total				84

TABLE 4.22 DISCRIMINANT ANALYSIS RESULTS FOR THE SAN FRANCISCO PENINSULA ROUTE

	APPROXIMATE F		PREDICTIVE MATRIX				PERCENT CORRECT
			Car	Bus	Car Pool	Rail	
All variables	3.8 d.f. (66,404)	Car	10	0	2	1	77
		Bus	1	22	1	7	73
		Car Pool	1	0	3	0	75
		Rail	3	7	0	103	91
		Total					86
12 Soft variables	5.5 d.f. (36,429)	Car	8	0	2	3	61
		Bus	0	23	1	6	77
		Car Pool	1	0	3	0	75
		Rail	6	10	1	96	85
		Total					81
9 Hard variables	1.7 d.f. (27,433)	Car	6	3	2	2	46
		Bus	6	13	4	7	43
		Car Pool	1	0	3	0	75
		Rail	11	37	12	53	47
		Total					47
5 Best variables	12.5 d.f. (16,420)	Car	7	1	3	2	54
		Bus	0	21	2	7	70
		Car Pool	1	0	3	0	75
		Rail	8	14	3	88	78
		Total					74
5 Average best variables	9.4 d.f. (15,420)	Car	6	1	3	3	46
		Bus	1	20	3	6	67
		Car Pool	1	0	2	1	50
		Rail	4	20	6	83	74
		Total					70

Table 4.23 shows the results of this investigation. As before, the soft variables do a creditable job and outperform the hard variables.

As indicated above, the five average best variables were:

6 - Seat Comfort
7 - Vehicle Spaciousness
11 - Personal Safety
12 - Vehicle Appeal
13 - Use of Time

The order of importance of these five variables for the three single corridors was:

Golden Gate	Bay Bridge	San Francisco Peninsula
12	12	13
13	13	12
6	7	6
11	11	7
7	6	11

In all cases, vehicle appeal and use of time are the most important soft variables.

The coefficients and constants of the discriminant functions for variables 6, 7, 11, 12, 13 as they are used in the single corridor and pooled corridor investigations are listed in Table 4.24.

Figure 4.21 is an example of the discriminant analysis output. The example is for the Golden Gate Route in the single corridor approach and is the basis for Table 4.20.

In summary, discriminant analysis was performed on data from both the Northeast Corridor and the San Francisco Bay Area. Only the Bay Area data included attitudinal responses. The percentages of individuals assigned correctly to modes in the three city-pairs in the Northeast Corridor were: 75%, 79%, and 80%. For the three corridors investigated in the Bay Area, the percentages assigned correctly were: 70%, 82%, and 84%. The latter assignments were made using the best five variables - all of which attitude variables. The results indicate that attitude response can do an adequate job in reproducing modal split choices.

TABLE 4.23

DISCRIMINANT ANALYSIS RESULTS FOR THE POOLED CORRIDOR APPROACH

	APPROXIMATE F		PREDICTIVE MATRIX					PERCENT CORRECT
			Car	Bus	Car Pool	Rail	Ferry	
All variables	11.4 d.f. (88,1932)	Car	22	1	5	2	4	65
		Bus	11	217	17	32	7	76
		Car Pool	3	1	22	3	0	76
		Rail	3	15	4	83	8	73
		Ferry	1	0	2	2	49	91
		Total						76
12 Soft variables	16.5 d.f. (48,1920)	Car	20	1	8	4	1	59
		Bus	13	199	13	51	8	70
		Car Pool	7	1	18	1	2	62
		Rail	4	18	7	73	11	65
		Ferry	2	3	2	3	44	82
		Total						69
9 Hard variables	4.3 d.f. (36,1879)	Car	20	6	7	7	4	59
		Bus	54	58	84	54	34	20
		Car Pool	3	3	17	3	3	59
		Rail	11	7	19	63	13	56
		Ferry	5	6	8	3	32	59
		Total						37
5 Average best as defined in single corridor travel	30.8 d.f. (20,1676)	Car	22	1	7	0	4	65
		Bus	12	199	17	48	8	70
		Car Pool	9	1	12	5	2	41
		Rail	3	26	10	55	19	49
		Ferry	1	1	5	7	40	74
		Total						64

TABLE 4.24

COEFFICIENT AND CONSTANTS OF THE DISCRIMINANT FUNCTIONS FOR VARIABLES 6, 7, 11, 12 & 13.

APPROACH	VARIABLE	COEFFICIENT CAR	COEFFICIENT BUS	COEFFICIENT CAR POOL	COEFFICIENT RAIL	COEFFICIENT FERRY
Golden Gate	6	.63	.24	.54		-.67
	7	.14	-.38	-.43		.44
	11	.94	2.03	1.36		1.94
	12	2.54	.69	2.35		2.37
	13	.49	.58	.68		1.05
	Constant	-19.44	-10.30	-17.12		-22.28
Oakland Bridge	6	.82	.36	.39		
	7	1.51	.82	1.34		
	11	1.22	2.11	1.74		
	12	1.81	.80	1.97		
	13	-.38	.45	-.005		
	Constant	-18.20	-14.33	-19.85		
San Francisco Peninsula	6	.81	.29	1.29	.07	
	7	.74	.35	.91	.75	
	11	1.48	1.69	1.36	1.78	
	12	1.36	.30	.82	.67	
	13	-.63	.01	-.37	.48	
	Constant	-15.50	-8.35	-17.14	-14.21	
Pooled Corridors	6	.66	.29	.60	.04	-1.09
	7	.91	.29	.54	.93	1.72
	11	1.22	1.90	1.47	1.88	2.09
	12	1.54	.54	1.50	.65	1.44
	13	-.27	.36	.07	.65	.71
	Constant	-16.41	-11.33	-16.13	-15.84	-22.02

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HEALTH SCIENCES COMPUTING FACILITY, UCLA

PROBLEM CODE TaP

NUMBER OF VARIABLES 22

NUMBER OF GROUPS 4

NUMBER OF CASES IN EACH GROUP 10 63 14 54

PRIOR PROBABILITIES 0.2500 0.2500 0.2500 0.2500

VARIABLE FORMAT %10X,F2.0,5X,F2.0,9X,F1.0,F5.0,7X,F1.0,1X,2F1.0,1X,3F1.0,4X,2F1.0,1X,
F1.0/19X,F1.0,13X,F2.0,F5.0,7X,3F1.0,7X,3F1.0<

DATA INPUT FROM CARDS

MEANS %THE LAST COLUMN CONTAINS THE GRAND MEANS OVER THE GROUPS USED IN THE ANALYSIS<

VARIABLE	GROUP A4	B5	C6	D22	
1	6.10000	4.79365	5.21428	7.55556	5.98582
2	7.30000	6.04762	8.57143	7.90741	7.09929
3	4.70000	4.39682	5.85714	6.14815	5.23404
4	195.50000	89.46031	88.57143	62.20369	86.45389
5	7.30000	7.21587	6.57143	7.14815	7.24113
6	8.50000	3.95238	7.14286	5.87037	5.32624
7	7.90000	3.79365	6.14286	7.68518	5.80851
8	6.20000	3.85714	7.21428	6.83333	5.63830
9	7.90000	3.76190	6.50000	7.01852	5.57447
10	8.30000	5.80952	7.78571	8.38889	7.17021
11	6.50000	6.50794	6.71428	8.40741	7.25532
12	8.30000	3.76190	7.35714	7.44444	5.85106
13	5.10000	4.42857	5.57143	7.96296	5.94326
14	6.40000	4.01587	7.00000	7.09259	5.65957
15	2.00000	2.07936	1.85714	2.51852	2.21986
16	4.60000	4.49206	4.28571	4.20370	4.36879
17	1.20000	1.20635	1.07143	1.18519	1.18440
18	4.50000	4.65079	4.71428	4.64815	4.64539
19	2.50000	3.15873	3.57143	2.87037	3.04255
20	4.00000	3.79365	3.50000	4.19518	3.92908
21	5.20000	5.63492	5.35714	6.05556	5.78723
22	2.60000	2.60317	2.28571	2.35185	2.47518

Figure 4.21

Example of Discriminant Analysis Program Output (Golden Gate Route Analysis)

Figure 4.21 (Continued)

STANDARD DEVIATIONS

VARIABLE	GROUP A4	B5	C6	D22
1	1.44914	2.14875	1.47693	1.48789
2	2.58414	2.03540	1.08941	1.55731
3	2.16282	1.31418	1.35062	1.36544
4	136.06459	48.88634	48.92805	20.43704
5	1.88556	1.59122	0.85163	1.74191
6	0.84984	2.12837	1.65748	1.73799
7	1.37032	2.17135	2.59755	1.35735
8	1.31656	[illegible]	1.71772	1.74561
9	1.91195	2.35343	1.50640	1.44706
10	1.05935	2.57065	1.25137	1.18825
11	2.36878	1.84804	2.23361	1.01903
12	1.33749	1.70118	1.33631	1.29828
13	3.26125	[illegible]	2.84778	1.51673
14	2.27[illegible]	1.77339	1.17670	1.61676
15	[illegible]	0.90342	0.36314	1.57505
16	0.69921	0.71556	1.20439	0.68349
17	0.42164	0.40793	0.26726	0.39209
18	1.26929	1.34594	0.99449	1.18413
19	1.35401	1.27262	1.08941	1.34650
20	0.94281	0.78614	0.94054	0.91268
21	1.75119	1.55855	1.02710	2.10495
22	0.69921	0.73043	0.82542	0.64887

WITHIN GROUPS CORRELATION MATRIX

VARIABLE	VARIABLES 1	2	3	4	5	6	7	8	
1	1.00000								
2	0.28600	1.00000							
3	0.17840	0.12601	1.00000						
4	-0.19673	-0.29010	-0.29214	1.00000					
5	0.04658	0.30769	0.20630	-0.14132	1.00000				
6	0.21069	0.07173	0.03868	0.11684	0.13546	1.00000			
7	0.20209	0.15960	0.02636	-0.03596	0.21084	0.65951	1.00000		
8	0.26148	0.14831	0.19222	-0.11565	0.21718	0.58318	0.57060	1.00000	
9	0.27541	0.11639	0.15566	-0.00006	0.20338	0.61507	0.53936	0.73846	1.0
10	0.36772	0.13614	0.14468	-0.12751	0.10436	0.48129	0.48122	0.55080	0.5
11	0.24027	0.16035	0.06818	-0.15038	0.27261	0.38271	0.45223	0.32926	0.3
12	0.22591	0.22870	0.12447	-0.00200	0.18011	0.63290	0.56116	0.58326	0.6
13	0.17394	0.25871	0.07092	-0.01432	0.06983	0.14947	0.25017	0.18019	0.31
14	0.33058	0.36943	0.22524	-0.22686	0.29631	0.47368	0.52562	0.50871	0.5
15	0.08998	0.05669	-0.26589	-0.06102	-0.14041	0.00387	0.04024	-0.13572	-0.1
16	-0.11164	-0.02891	-0.07852	0.12425	0.17007	0.02715	-0.04588	-0.00898	0.0
17	0.19233	-0.00879	-0.07808	-0.03151	-0.05595	0.12682	0.04797	-0.07887	-0.0
18	-0.08250	-0.05071	-0.02292	0.10792	0.20177	-0.00137	0.06932	-0.04719	0.0
19	-0.11922	-0.02526	-0.04531	-0.07920	0.11102	-0.06343	0.01255	0.02526	-0.0
20	-0.05474	0.03480	0.20233	-0.28437	0.08215	-0.11409	-0.12706	-0.02517	-0.0
21	-0.13036	-0.03852	0.08516	-0.14346	0.07013	-0.13967	0.04067	-0.07083	-0.0
22	-0.07446	-0.21439	0.05475	0.10571	-0.03504	-0.00164	0.08602	-0.02945	0.0

Figure 4.21 (Continued)

VARIABLE	VARIABLES 10	11	12	13	14	15	16	17	
10	1.00000								
11	0.45124	1.00000							
12	0.44432	0.40444	1.00000						
13	0.32312	0.19994	0.18447	1.00000					
14	0.42423	0.46533	0.52214	0.34616	1.00000				
15	-0.07919	-0.05478	0.03135	-0.14061	-0.09123	1.00000			
16	-0.00649	0.08543	0.19306	-0.17335	-0.00511	-0.17008	1.00000		
17	0.07888	0.12960	0.09567	-0.07624	0.02262	0.27248	-0.14466	1.00000	
18	-0.03663	-0.03402	-0.10853	0.07588	-0.04418	-0.24694	0.12889	-0.35294	1.0
19	-0.10251	-0.06580	-0.07111	-0.04280	-0.10783	-0.20996	0.20906	-0.30813	0.
20	-0.06487	-0.08351	-0.16949	0.10773	0.09572	-0.27139	0.03726	-0.25221	0.
21	-0.09082	-0.10180	-0.15085	-0.06425	0.00312	-0.27142	0.15219	-0.40217	0.
22	0.07396	-0.07964	-0.05243	-0.14787	-0.01066	-0.04715	-0.00421	-0.04861	0.

VARIABLE	VARIABLES 19	20	21	22
19	1.00000			
20	0.20548	1.00000		
21	0.41375	0.46835	1.00000	
22	0.16087	0.03971	0.37601	1.00000

SUBPROBLEM 1
F-LEVEL FOR INCLUSION 0.0
F-LEVEL FOR DELETION 0.0
TOLERANCE LEVEL 0.0
CONTROL VALUES 1111111111111111111111

****

STEP NUMBER 0
VARIABLE ENTERED

VARIABLES NOT INCLUDED AND F TO ENTER - DEGREES OF FREEDOM 3 137

1	23.4216	5	3.6187	9	40.5045	13	25.8808	17	0.4600	21	0.9487
2	13.4434	6	25.6373	10	19.0567	14	35.7751	18	0.0598	22	1.6708
3	16.3485	7	45.3593	11	13.9421	15	2.0834	19	1.8613		
4	13.7726	8	34.3870	12	74.6787	16	1.7521	20	3.2807		

****

STEP NUMBER 1
VARIABLE ENTERED 12

Figure 4.21 (Continued)

VARIABLES INCLUDED AND F TO REMOVE - DEGREES OF FREEDOM 3 137

12 74.67[illegible]

VARIABLES NOT INCLUDED AND F TO ENTER - DEGREES OF FREEDOM 3 136

1	9.7512	4	15.6290	7	4.8929	10	0.7358	14	3.3998	17	0.8574	20	4.[illegible]
2	2.6[illegible]	5	3.2515	8	1.0180	11	9.0150	15	1.6614	18	0.3556	21	1.[illegible]
3	[illegible]	6	7.7631	9	1.0653	13	12.1556	16	3.5515	19	1.4459	22	0.[illegible]

U-STATISTIC 0.37946 DEGREES OF FREEDOM 1 3 137
APPROXIMATE F 74.67877 DEGREES OF FREEDOM 3 137.00

F MATRIX - DEGREES OF FREEDOM 1 137

GROUP	A4	B5	C6
B5	79.03670		
C6	2.30697	65.44105	
D22	2.74646	175.35059	0.03768

****

1	2.[illegible]4	5	[illegible]3644	9	0.6761	13	2.8[illegible]	17	0.0318	21	0.9198
2	1.14[illegible]	6	5.7640	10	0.7452	14	1.3972	18	0.1223	22	1.0478
3	2.41[illegible]	7	5.3673	11	3.4724	15	1.4079	19	0.8054		
4	7.9555	8	0.4156	12	3.6215	16	1.5262	20	5.7724		

U-STATISTIC 0.08617 DEGREES OF FREEDOM 22 3 137
APPROXIMATE F 6.69526 DEGREES OF FREEDOM 66 347.26

F MATRIX - DEGREES OF FREEDOM 22 116

GROUP	A4	B5	C6
B5	6.57005		
C6	2.72567	4.90388	
D22	4.68470	14.17454	5.06767

F LEVEL INSUFFICIENT FOR FURTHER COMPUTATION

VARIABLE	FUNCTION A4	B5	C6	D22
1	2.59026	0.39507	0.70711	0.82708
2	2.09457	2.23022	2.62639	2.20705
3	3.37615	3.73111	4.22890	4.59111
4	0.19557	0.13654	0.14884	0.14697
5	0.45136	0.56645	0.65589	0.11586
6	-0.[illegible]	-0.43773	-0.29[illegible]	-1.47938
7	-0.12231	-0.66980	-1.26152	0.06860
8	3.[illegible]	3.02647	3.18264	2.88727
9	-1.35167	-1.43020	-1.71650	-1.08152

Figure 4.21 (Continued)

10	0.75977	0.55420	0.90445	0.42335
11	1.82[illegible]	2.41490	1.63245	2.52154
12	[illegible]	-1.21563	0.35077	0.49669
13	0.73154	1.46322	1.39904	1.76385
14	-1.14333	-1.09027	-0.40855	-1.12069
15	6.42883	6.30651	6.37555	7.05079
16	8.69490	9.55930	8.11289	8.95166
17	19.25436	19.00215	18.75955	18.90338
18	2.60325	2.72006	2.58731	2.88131
19	0.75587	0.93434	1.46550	0.94311
20	9.59096	7.43692	6.61854	8.42341
21	1.51475	1.26857	1.83024	1.53281
22	4.27079	4.86038	3.64085	4.07349

CONSTANT

-131.04596	-105.62694	-112.92822	-125.32874

GROUP WITH LARGEST PROB.

SQUARE OF DISTANCE FROM AND POSTERIOR PROBABILITY FOR GROUP -

GROUP A4 CASE		A4	B5	C6	D22
1	C6	19.055 0.008,	21.906 0.002,	9.433 0.966,	16.840 0.024,
2	A4	30.890 1.000,	56.506 0.000,	47.981 0.000,	57.214 0.000,
3	D22	42.753 0.342,	51.000 0.005,	44.122 0.172,	42.072 0.480,
4	A4	29.174 0.997,	54.049 0.000,	41.446 0.003,	53.079 0.000,
5	A4	26.462 0.629,	32.109 0.002,	28.669 0.010,	21.182 0.359,
6	A4	28.039 1.000,	62.035 0.000,	48.542 0.000,	65.975 0.000,
7	D22	26.113 0.010,	31.911 0.001,	28.917 0.003,	17.008 0.986,
8	A4	28.770 1.000,	64.634 0.000,	55.193 0.000,	54.208 0.000,
9	A4	21.569 0.999,	43.843 0.000,	41.091 0.000,	34.744 0.001,
10	A4	36.379 1.000,	63.467 0.000,	59.750 0.000,	65.275 0.000,

Figure 4.21 (Continued)

GROUP B5 CASE		A4		B5		C6		D22	
1	D22	23.347	0.000,	22.729	0.012,	17.915	0.130,	14.163	0.849,
2	D22	91.519	0.000,	65.120	0.345,	78.278	0.000,	63.841	0.654,
3	A4	18.034	0.917,	24.390	0.038,	24.230	0.041,	29.228	0.003,
4	B5	41.472	0.000,	19.952	0.397,	33.279	0.001,	32.820	0.002,
5	B5	36.407	0.000,	14.364	0.986,	30.250	0.000,	22.889	0.014,
6	B5	57.216	0.000,	20.957	1.000,	37.955	0.000,	48.676	0.000,
7	B5	25.697	0.000,	9.789	0.879,	15.260	0.057,	15.036	0.064,
8	B5	37.256	0.000,	9.390	0.997,	21.172	0.003,	25.309	0.000,
9	B5	46.051	0.000,	22.031	1.000,	38.233	0.000,	45.907	0.000,
10	B5	39.005	0.000,	21.345	0.986,	29.845	0.014,	41.066	0.000,
11	B5	47.085	0.000,	20.455	0.987,	29.214	0.012,	35.732	0.000,
12	C6	19.074	0.004,	10.180	0.369,	9.113	0.627,	21.450	0.001,
13	A4	43.786	0.704,	46.244	0.206,	56.125	0.001,	47.931	0.089,
14	B5	47.121	0.053,	41.435	0.917,	55.160	0.001,	48.340	0.029,
15	B5	34.461	0.001,	20.251	0.997,	32.907	0.002,	34.349	0.001,
16	B5	35.703	0.002,	23.538	0.797,	40.018	0.000,	26.296	0.201,
17	B5	45.245	0.000,	20.807	0.996,	31.850	0.004,	37.992	0.000,
18	B5	45.011	0.000,	15.775	0.999,	31.067	0.000,	30.255	0.001,
19	B5	49.031	0.000,	21.580	0.985,	34.425	0.002,	33.180	0.013,
20	B5	41.247	0.032,	34.451	0.962,	44.678	0.006,	53.476	0.000,
21	B5	22.944	0.009,	13.518	0.985,	23.665	0.006,	30.609	0.000,
22	B5	36.646	0.000,	13.649	0.946,	19.377	0.054,	28.831	0.000,
23	B5	50.021	0.000,	17.033	1.000,	38.766	0.000,	38.294	0.000,
24	B5	48.868	0.000,	24.508	0.987,	40.268	0.000,	33.212	0.013,
25	B5	51.835	0.000,	20.986	0.999,	37.863	0.000,	34.542	0.001,
26	B5	57.331	0.000,	29.181	0.999,	46.480	0.000,	42.793	0.001,
27	B5	25.929	0.000,	8.215	0.941,	14.310	0.045,	16.642	0.014,
28	B5	47.192	0.000,	39.932	1.000,	52.650	0.000,	50.554	0.000,
29	B5	40.639	0.002,	29.609	0.875,	33.275	0.085,	34.978	0.036,
30	B5	41.518	0.000,	12.215	0.997,	24.023	0.003,	26.676	0.001,
31	B5	52.926	0.000,	37.871	0.888,	42.104	0.107,	48.485	0.004,
32	B5	27.766	0.001,	14.132	0.518,	18.902	0.057,	15.418	0.325,
33	B5	52.466	0.000,	34.984	0.997,	47.055	0.002,	49.014	0.001,
34	B5	66.024	0.000,	33.319	1.000,	51.311	0.000,	49.142	0.000,
35	B5	46.734	0.000,	24.977	1.000,	41.270	0.000,	42.978	0.000,
36	B5	33.723	0.000,	17.599	0.979,	27.418	0.007,	26.106	0.014,
37	B5	25.952	0.008,	16.413	0.911,	22.590	0.041,	22.663	0.040,
38	B5	43.012	0.000,	24.720	0.944,	35.634	0.004,	30.506	0.052,
39	B5	52.131	0.000,	33.920	0.940,	39.415	0.060,	56.069	0.000,
40	B5	40.872	0.000,	15.083	0.997,	26.856	0.003,	30.081	0.001,
41	C6	18.609	0.244,	21.505	0.047,	17.325	0.464,	18.600	0.245,
42	B5	51.459	0.000,	24.339	0.999,	45.213	0.000,	38.521	0.001,
43	B5	41.182	0.000,	17.116	0.999,	31.353	0.001,	35.363	0.000,
44	B5	39.463	0.000,	17.214	0.998,	29.866	0.002,	35.554	0.000,
45	B5	42.329	0.000,	15.145	0.994,	25.693	0.005,	29.305	0.001,
46	B5	46.373	0.001,	31.889	0.988,	48.085	0.000,	40.859	0.011,
47	B5	40.379	0.000,	12.459	1.000,	29.354	0.000,	29.945	0.000,
48	B5	37.174	0.003,	21.243	0.727,	23.262	0.265,	31.306	0.005,
49	B5	48.764	0.000,	16.240	1.000,	34.178	0.000,	38.657	0.000,
50	B5	39.038	0.000,	15.491	0.975,	22.844	0.025,	39.053	0.000,

Figure 4.21 (Continued)

51	B5	47.996 0.000,	19.219 0.999,	33.010 0.001,	38.413 0.000,
52	B5	16.009 0.096,	13.363 0.360,	13.899 0.275,	13.945 0.269,
53	B5	62.911 0.000,	15.199 1.000,	37.176 0.000,	47.827 0.000,
54	B5	21.725 0.004,	10.765 0.964,	19.234 0.014,	18.729 0.018,
55	B5	37.690 0.000,	16.559 0.998,	28.828 0.002,	37.790 0.000,
56	B5	44.298 0.000,	21.550 0.986,	36.280 0.001,	30.198 0.013,
57	B5	59.102 0.000,	16.761 1.000,	43.434 0.000,	49.589 0.000,
58	B5	34.174 0.000,	14.162 0.997,	29.438 0.000,	26.322 0.002,
59	B5	43.355 0.000,	17.297 0.992,	27.104 0.007,	33.537 0.000,
60	B5	38.095 [illegible] 000,	9.972 0.999,	24.210 0.001,	26.7[illegible] 0.000,
61	B5	38.150 [illegible].000,	17.980 0.948,	25.119 0.027,	25.2[illegible] 0.025,
62	B5	43.588 0.000,	12.272 1.000,	35.011 0.000,	31.137 0.000,

GROUP C6 CASE		A4	B5	C6	D22
1	C6	27.031 0.000,	23.008 0.002,	10.892 0.996,	2[illegible].263 0.002,
2	C6	40.375 0.000,	29.620 0.002,	17.274 0.992,	27.488 0.006,
3	C6	66.074 0.000,	58.551 0.000,	40.277 1.000,	63.924 0.000,
4	C6	34.275 0.000,	26.634 0.017,	18.488 0.982,	33.052 0.001,
5	A4	8.576 0.826,	20.668 0.002,	12.119 0.141,	15.138 0.031,
6	C6	31.756 0.001,	33.373 0.000,	16.735 0.998,	30.584 0.001,
7	C6	31.265 0.034,	30.810 0.043,	24.689 0.912,	33.452 0.011,
8	C6	37.441 0.157,	36.818 0.219,	34.875 0.579,	39.998 0.045,
9	C6	33.533 0.002,	31.208 0.006,	20.874 0.992,	39.394 0.000,
10	C6	33.317 0.000,	37.713 0.000,	17.240 1.000,	36.096 0.000,
11	C6	29.609 0.001,	32.401 0.000,	15.628 0.989,	24.809 0.010,
12	C6	23.062 0.020,	29.907 0.001,	15.320 0.969,	24.488 0.010,
13	C6	39.037 0.017,	35.286 0.112,	31.180 0.869,	43.132 0.002,
14	C6	21.238 0.006,	16.563 0.065,	11.332 0.893,	17.823 0.035,

GROUP D22 CASE		A4	B5	C6	D22
1	D22	29.144 0.053,	38.341 0.001,	28.490 0.074,	23.546 0.873,
2	B5	22.545 0.003,	11.305 0.811,	22.733 0.003,	14.282 0.183,
3	D22	30.758 0.001,	20.354 0.103,	29.966 0.001,	16.027 0.896,
4	D22	30.717 0.019,	37.704 0.001,	30.903 0.017,	22.882 0.963,
5	D22	33.975 0.001,	24.442 0.095,	31.230 0.003,	19.942 0.901,
6	D22	83.812 0.000,	77.275 0.000,	84.704 0.000,	61.535 1.000,
7	D22	21.479 0.005,	19.316 0.016,	16.579 0.063,	11.241 0.915,
8	D22	36.416 0.000,	30.133 0.002,	22.013 0.094,	17.489 0.904,
9	D22	35.944 0.004,	32.437 0.023,	39.694 0.001,	24.981 0.972,
10	D22	60.389 0.002,	55.683 0.016,	48.976 0.491,	48.975 0.491,
11	D22	28.073 0.001,	32.072 0.000,	20.178 0.065,	14.853 0.933,
12	D22	37.774 0.001,	40.114 0.000,	33.169 0.008,	23.516 0.991,
13	D22	32.597 0.001,	24.504 0.047,	28.617 0.006,	15.515 0.946,
14	D22	43.293 0.000,	42.555 0.000,	44.475 0.000,	23.348 1.000,
15	D22	35.512 0.000,	27.297 0.001,	29.616 0.000,	13.220 0.999,
16	D22	18.922 0.028,	24.615 0.002,	21.597 0.007,	11.752 0.963,
17	D22	49.239 0.000,	42.928 0.000,	49.605 0.000,	22.636 1.000,
18	B5	34.574 0.000,	16.520 0.997,	32.029 0.000,	28.198 0.003,
19	D22	22.711 0.004,	24.643 0.001,	13.616 0.338,	12.285 0.657,

Figure 4.21 (Concluded)

20	D22	37.587 0.000,	31.190 0.000,	32.354 0.000,	13.021 1.000,
21	D22	16.540 0.002,	19.827 0.000,	16.169 0.003,	4.565 0.994,
22	D22	21.159 0.002,	26.293 0.000,	21.267 0.002,	9.405 0.997,
23	D22	27.287 0.244,	31.712 0.027,	28.264 0.150,	25.563 0.579,
24	D22	21.061 0.008,	29.354 0.000,	21.827 0.005,	11.313 0.987,
25	D22	30.464 0.000,	33.001 0.000,	30.802 0.000,	12.221 1.000,
26	D22	32.608 0.000,	16.566 0.076,	22.699 0.004,	11.569 0.921,
27	D22	32.192 0.001,	29.318 0.006,	25.590 0.040,	19.235 0.953,
28	D22	34.742 0.000,	39.341 0.000,	39.038 0.000,	17.867 1.000,
29	D22	48.922 0.000,	43.683 0.000,	40.715 0.001,	25.742 0.999,
30	D22	19.571 0.004,	28.402 0.000,	18.616 0.007,	8.612 0.989,
31	D22	25.551 0.116,	30.570 0.009,	34.159 0.002,	21.521 0.873,
32	D22	50.295 0.002,	48.371 0.006,	58.267 0.000,	36.019 0.992,
33	D22	49.571 0.000,	41.983 0.001,	47.055 0.000,	25.400 0.999,
34	D22	26.336 0.002,	19.702 0.053,	21.458 0.022,	17.978 0.923,
35	D22	31.111 0.001,	23.381 0.028,	19.761 0.171,	16.668 0.801,
36	D22	44.953 0.000,	50.976 0.000,	38.429 0.013,	29.717 0.987,
37	D22	24.693 0.001,	20.894 0.007,	14.189 0.209,	11.545 0.783,
38	D22	61.198 0.000,	55.226 0.001,	54.134 0.001,	40.321 0.998,
39	D22	21.900 0.001,	19.969 0.002,	22.576 0.000,	7.311 0.997,
40	D22	56.865 0.000,	54.511 0.000,	57.411 0.000,	38.310 1.000,
41	D22	45.080 0.000,	41.169 0.000,	45.547 0.000,	24.129 1.000,
42	D22	25.634 0.002,	25.297 0.003,	22.517 0.010,	13.419 0.985,
43	D22	41.448 0.000,	41.058 0.000,	39.495 0.000,	21.313 1.000,
44	D22	[illegible] 0.003,	29.579 0.001,	21.390 0.010,	12.295 0.986,
45	D22	54.105 0.000,	46.773 0.000,	58.734 0.000,	29.787 1.000,
46	D22	27.520 0.001,	39.322 0.000,	25.185 0.002,	12.636 0.998,
47	D22	28.235 0.000,	26.733 0.000,	24.917 0.001,	11.373 0.998,
48	D22	17.584 0.066,	18.631 0.039,	18.180 0.049,	12.470 0.847,
49	D22	39.225 0.000,	35.987 0.000,	33.700 0.001,	20.510 0.998,
50	C6	26.322 0.009,	20.046 0.203,	17.466 0.737,	22.805 0.051,
51	D22	36.418 0.000,	31.467 0.001,	37.009 0.000,	17.586 0.999,
52	D22	27.739 0.164,	33.638 0.009,	36.193 0.002,	24.513 0.825,
53	D22	31.215 0.000,	29.905 0.001,	21.586 0.035,	14.962 0.964,
54	D22	42.089 0.000,	39.548 0.000,	36.562 0.000,	20.984 0.999,

NUMBER OF CASES CLASSIFIED INTO GROUP -

GROUP	A4	B5	C6	D22
A4	7	0	1	2
B5	2	56	3	2
C6	1	0	13	0
D22	0	2	1	51

4.10 INTRODUCTION OF PREFERENCE VARIABLES INTO A MODE-SPLIT MODEL

The trip rating survey included, in addition to rating scales, a question relating to the actual time in minutes spent on each mode used to complete a trip and the cost in dollars to utilize each required mode. When enroute trip time rating was plotted against actual time spent on mode, the results were amazingly linear for every mode. Excellent linear trends for overall trip rating with time on mode were also evident in the data. These relationships are shown in Figures 4.22 and 4.23. In the former, an estimated relationship for STOL was obtained by pinning a segment equal in length to 10 minutes at its center point at an enroute time rating of seven and then rotating it until it assumed a slope approximating the mean slope of all the existing modes except ferry.

The trends shown in Figure 4.23 mean that overall rating is almost independent of time spent on mode. Trip cost rating as a function of actual cost per modal portion of trip is shown in Figure 4.24. Overall trip rating versus actual cost is shown in Figure 4.25. Like the time relationship, overall trip rating appears to be almost independent of actual cost.

Time-distance relationships for the existing modes and for the proposed STOL mode have been estimated for the San Francisco intraurban area and were published in Reference 1. If the time-rating versus actual time function is combined with the time-distance relationship from Reference 1, an enroute time rating can be associated with every travel corridor of interest to this study. The technique for doing this is shown schematically in Figure 4.26. In essence the procedure simply makes a series of linear transformations on the rating in order to associate it with a distance. The actual enroute time rating versus distance functions that were obtained from the rating survey data and the time-distance functions of Reference 1 are shown in Figure 4.27. These relationships are the means by which attitudinal variables are inserted into a mode-split model.

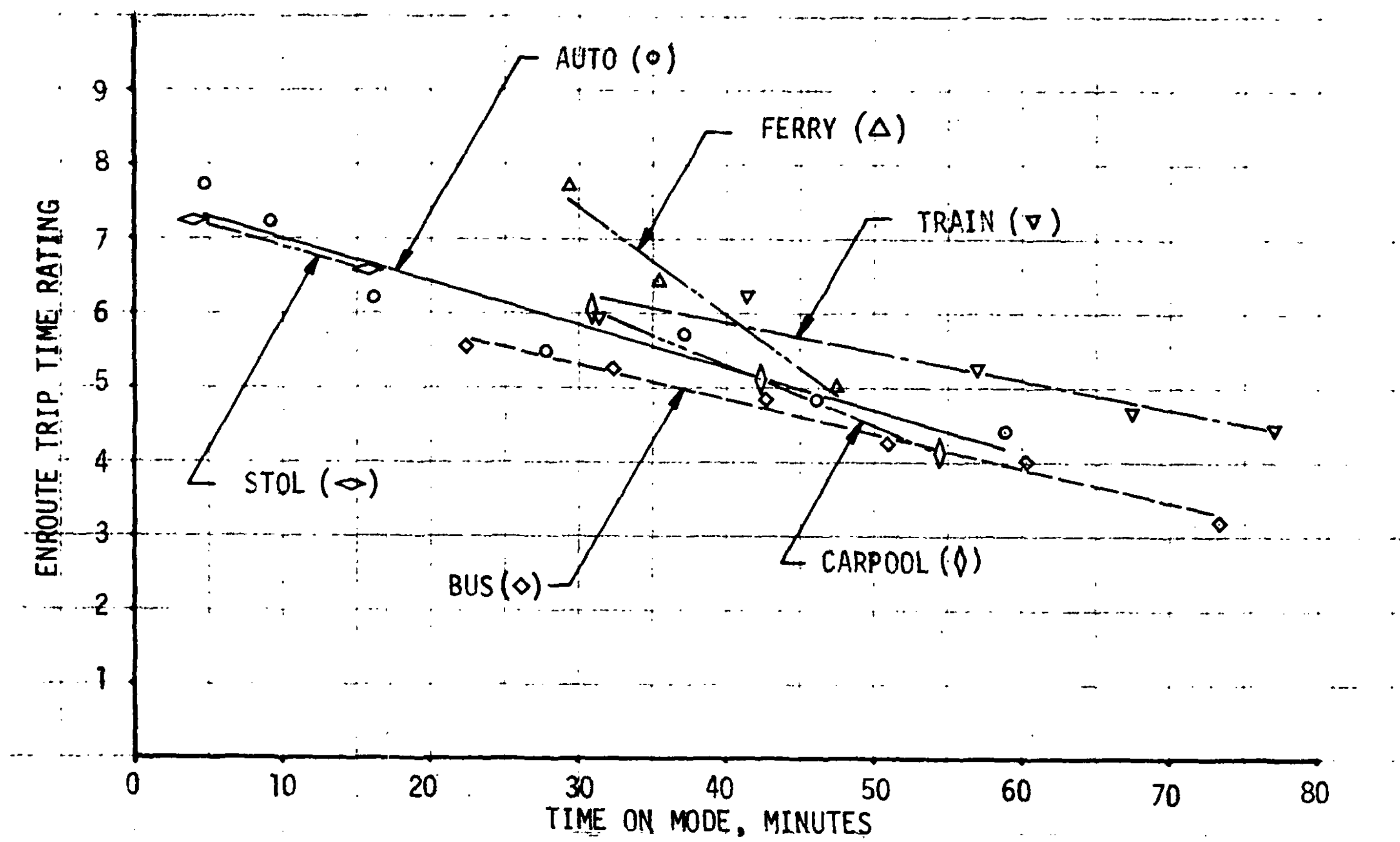


Figure 4.22 Trend of Trip Time Rating with Actual Time

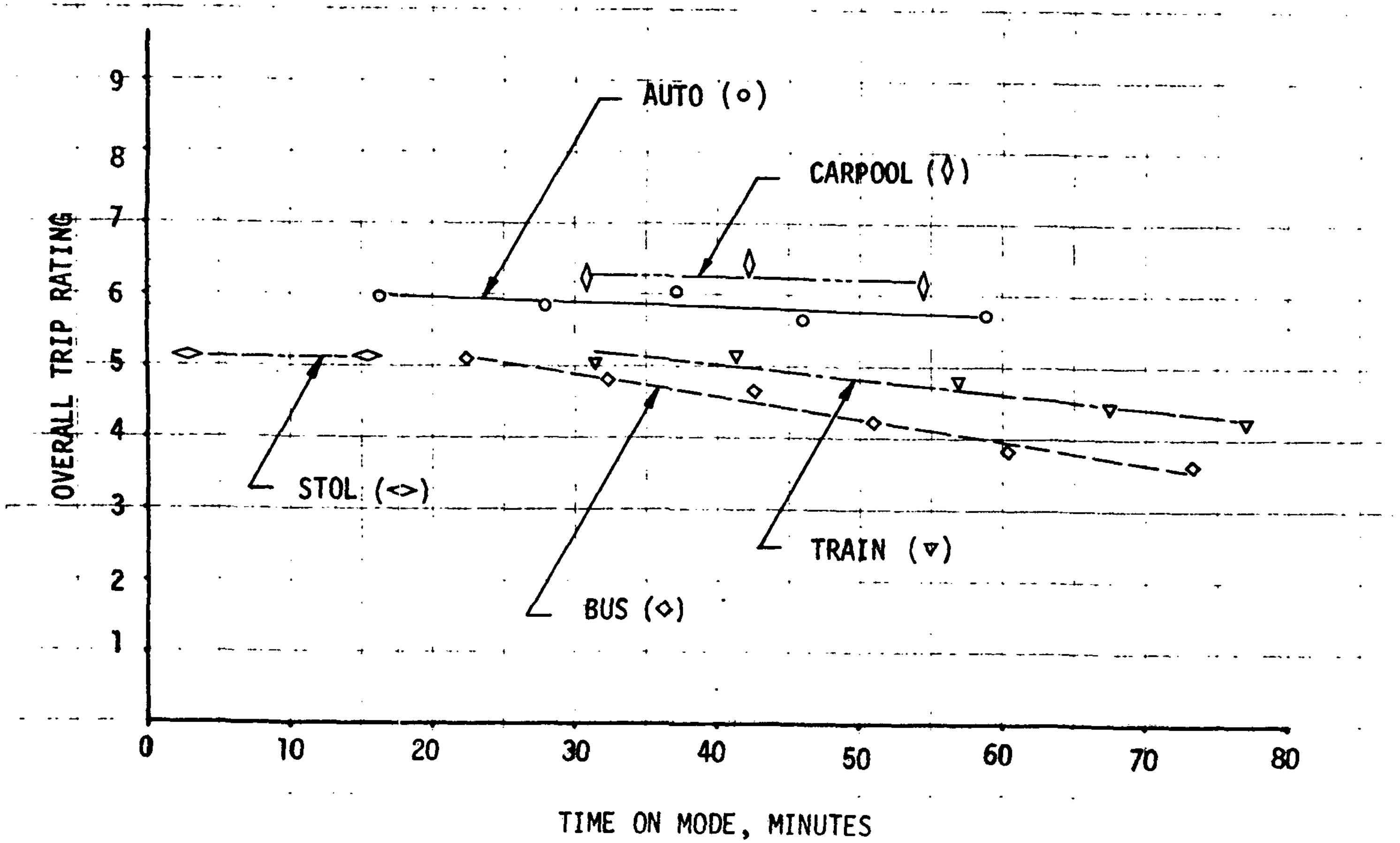


Figure 4.23 Trend of Overall Trip Rating with Actual Time

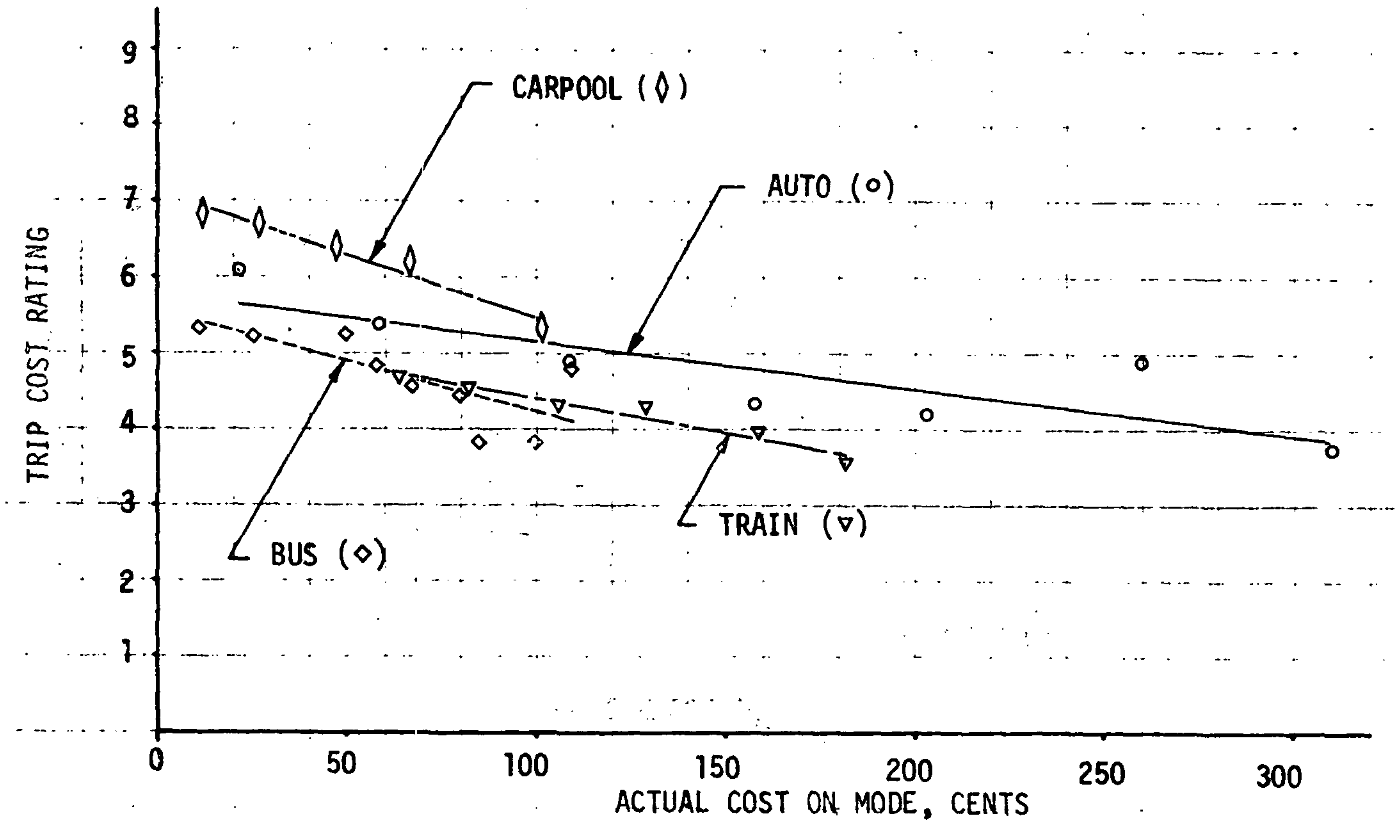


Figure 4.24 Trend of Trip Cost Rating with Actual Cost

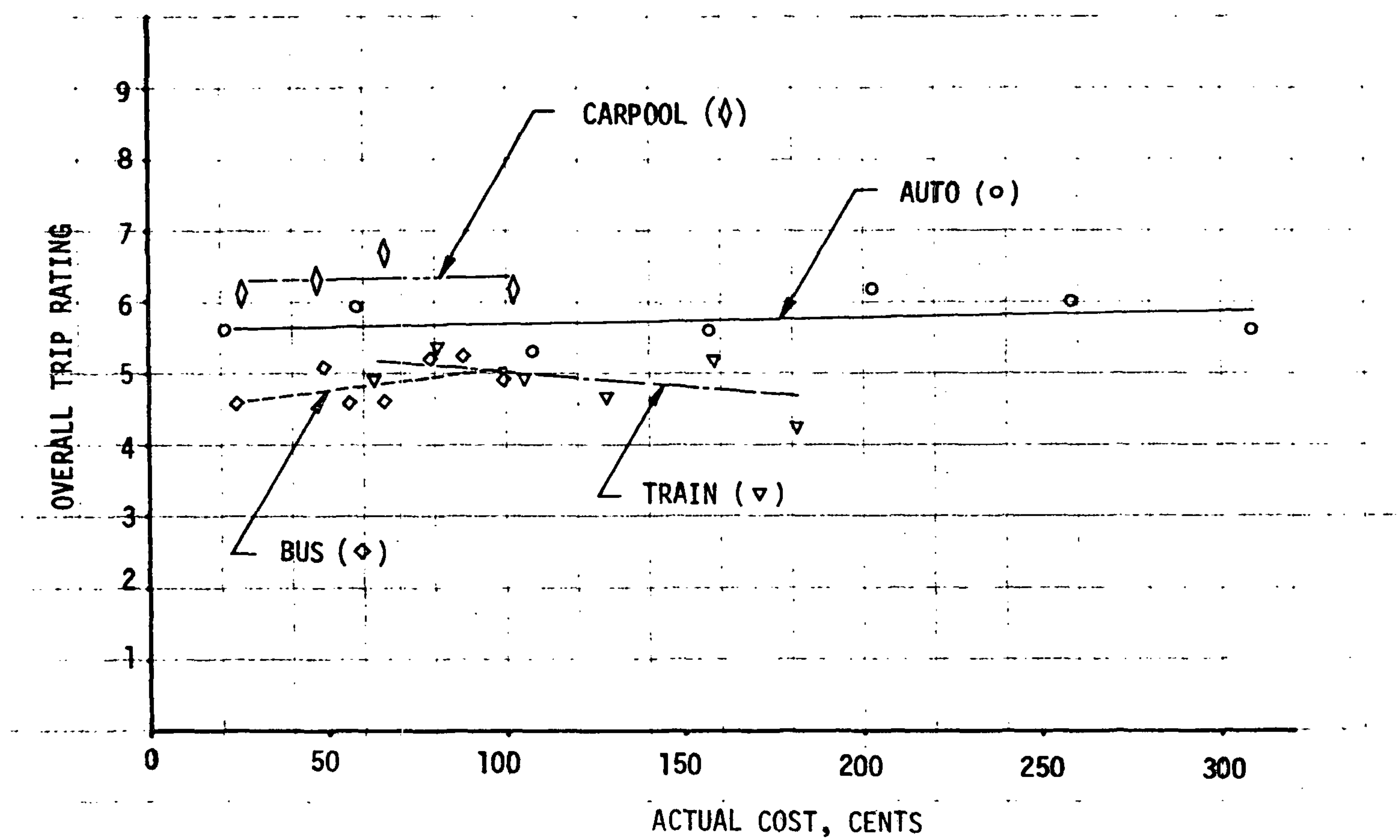


Figure 4.25 Trend of Overall Trip Rating with Actual Cost

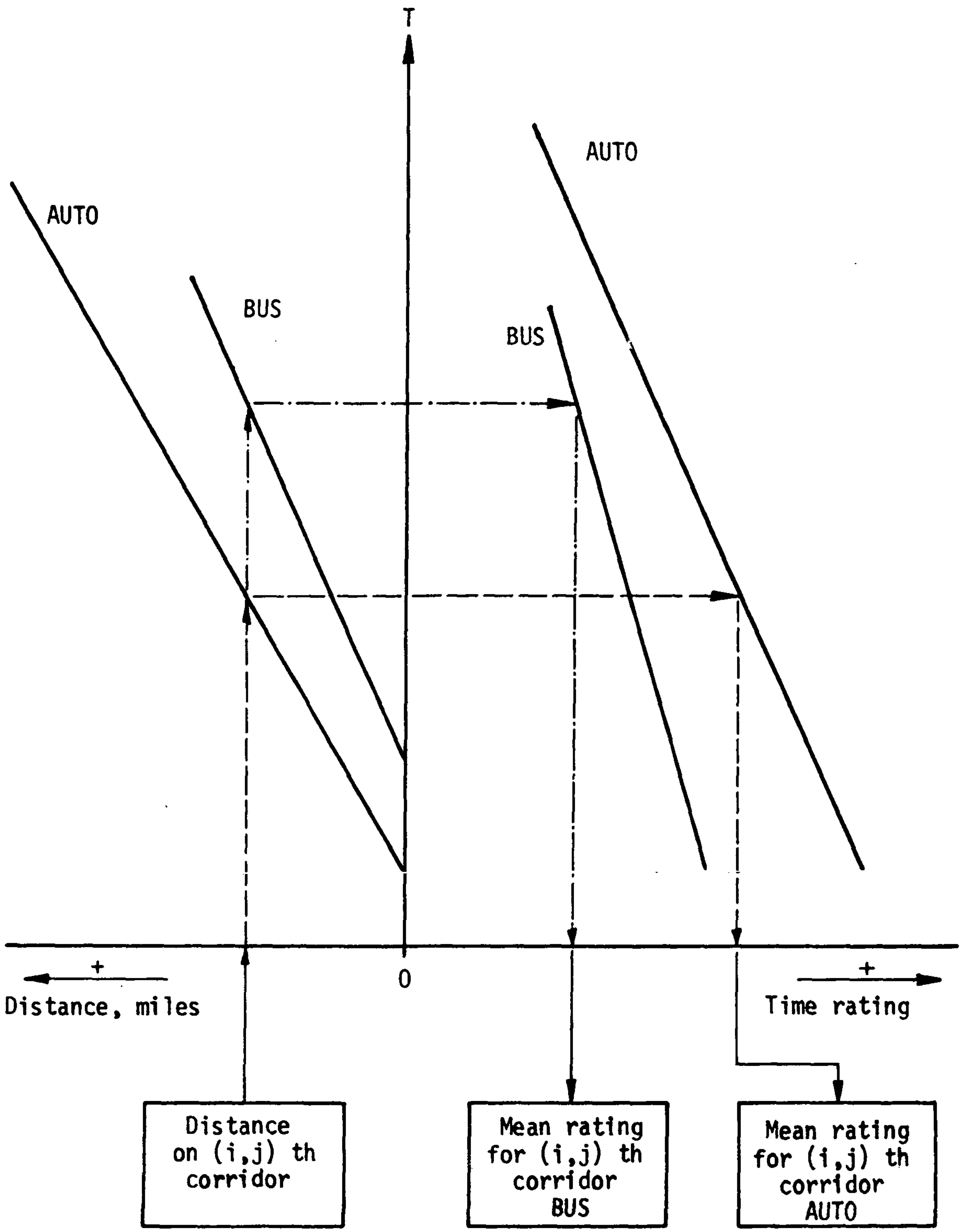


Figure 4.26

Scheme for Associating Enroute Trip Time Rating
with the (i, j) th Corridor

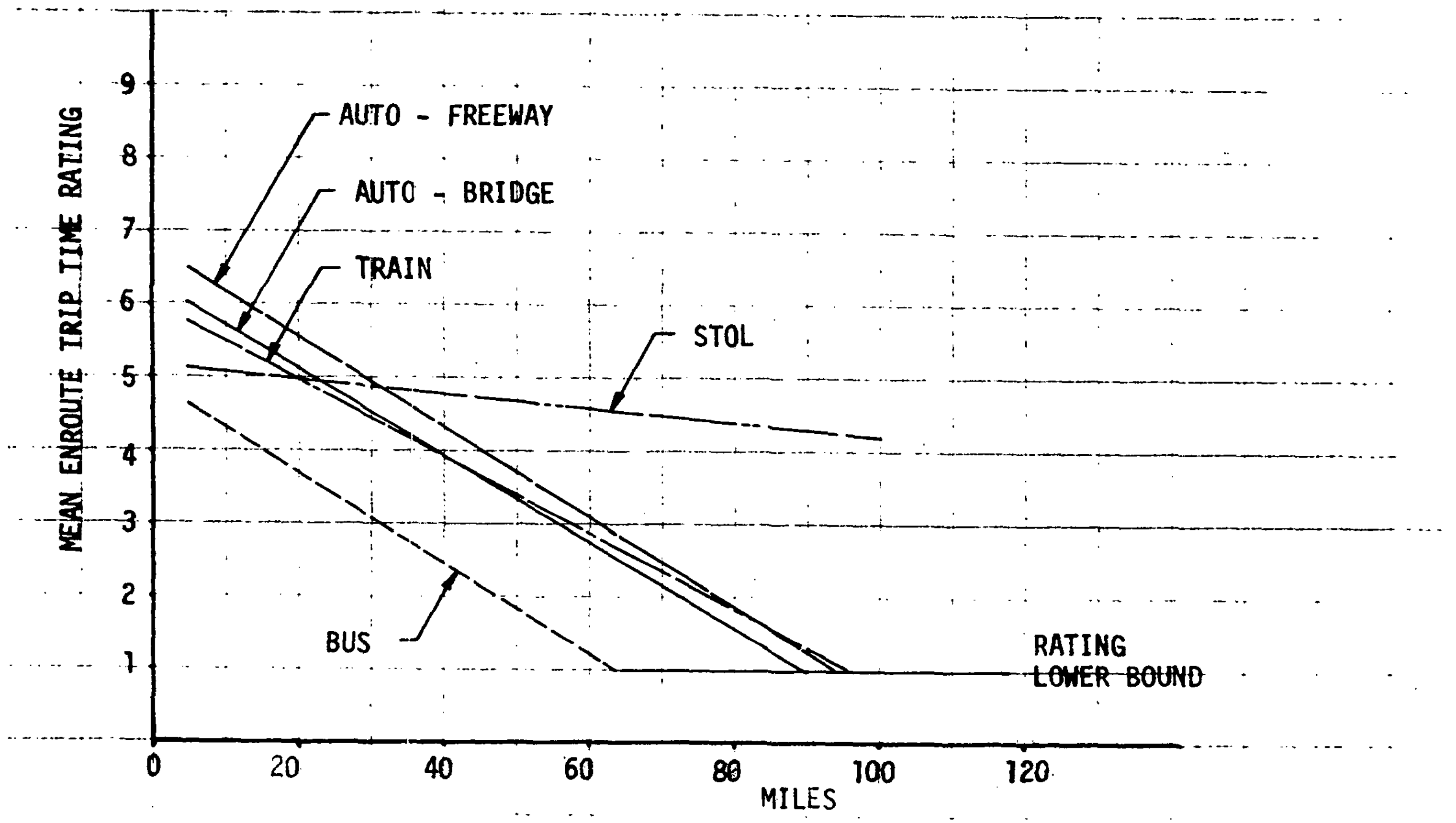


Figure 4.27 Relationship of Enroute Trip Time Rating with Distance

5.0 DEMAND MODEL

5.1 BAY AREA DATA BASE

The transportation demand models in this report are based on analysis of a portion of the very large travel data base available in the San Francisco Bay Area. This data base was developed by the Bay Area Transportation Study Commission (BATSC) which has since become the Regional Transportation Planning Committee (RTPC) and is currently the Metropolitan Transportation Commission (MTC).

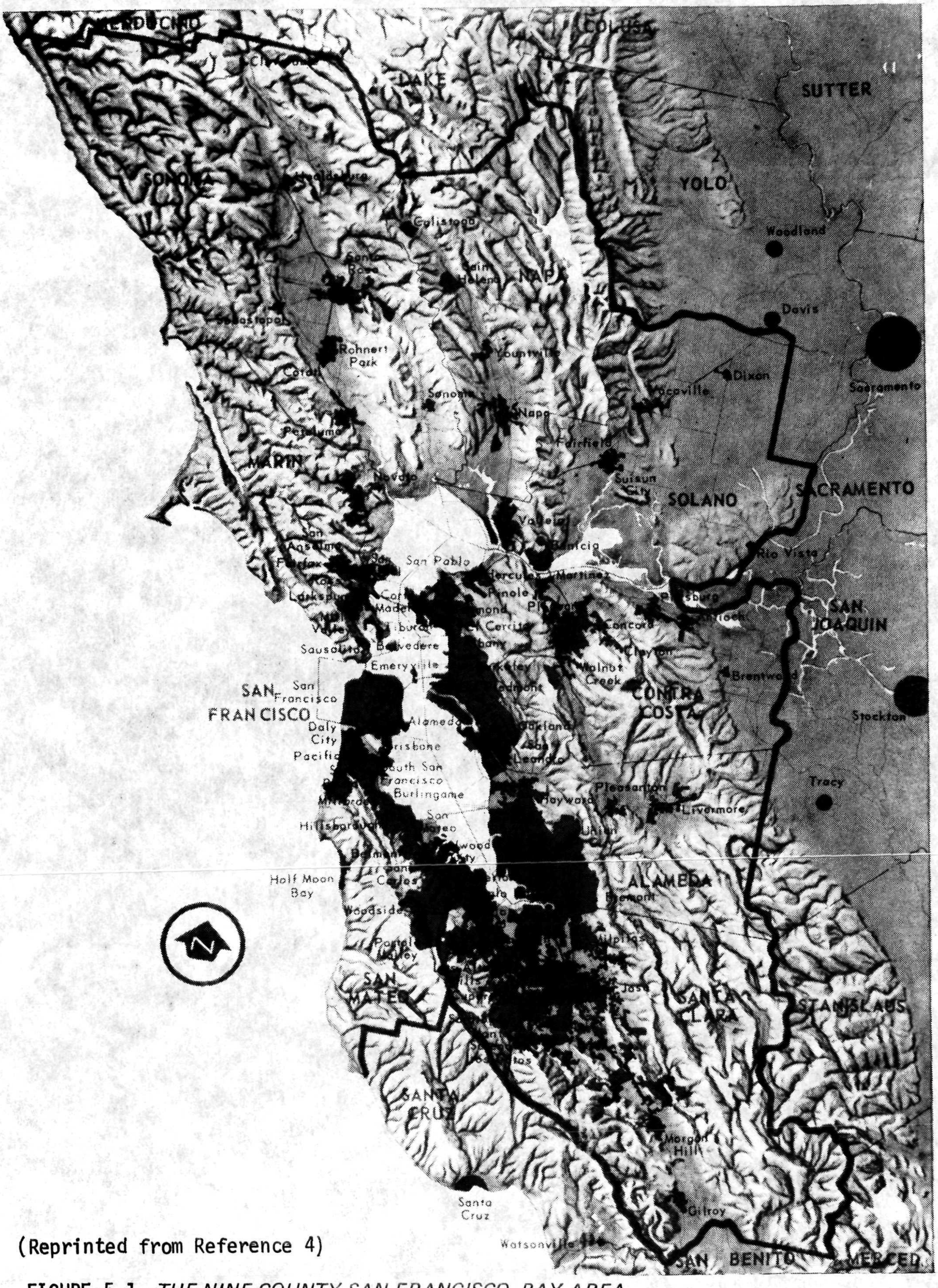
The BATSC data base (comprised of inventories and surveys) represents a $3.5 million investment, some 60% of the $6 million cost of the Bay Area Transportation Study.

The area included in this analysis is composed of the nine counties surrounding the Bay Area; i.e., San Francisco, San Mateo, Santa Clara, Alameda, Contra Costa, Solano, Napa, Sonoma, and Marin. A quote from Reference 4 helps to characterize the area:

> "In 1965, on these 4.5 million acres, lived 4.4 million people holding 1.7 million jobs. They owned about 2 million automobiles and motorcycles and 285,000 trucks. These operated on 1400 miles of state highways and 14,300 miles of county roads and city streets."

The San Francisco Bay and the hills around it, Figure 5.1, have a profound impact on the location and growth of the population and the transportation systems serving it. In the BATSC data base, the Bay Area is divided into seven levels of nested geographic units or zones; counties - 9, superdistricts - 30, districts - 98, analysis zones - 291, and three other levels going down to the census blocks. The trip files and demographic data used here were obtained at the 291 analysis-zone level and aggregated into 30 superzones. These 30 superzones were similar to the 30 superdistricts with some modification as described below.

The base year for this data is 1965, with most of the information coming from the Home Interview Survey. This survey consisted of approximately 30,000 home interviews selected randomly throughout the Bay Area, and covered trips and demographic information.



(Reprinted from Reference 4)

FIGURE 5.1 —*THE NINE-COUNTY SAN FRANCISCO BAY AREA*

Screenline and cordon surveys were also taken as an accuracy check on the expanded Home Interview Survey trip files. Reference 4 stated: "Close agreement was found between the sample and screenline data, and it was concluded that the expanded trip files, without further adjustment were sufficiently accurate to be used for model calibrations and planning analysis".

For the Intraurban Study, six reels of magnetic tape (from the 1000 available) were utilized, in addition to several documents. The tapes consisted of a 291 x 291 matrix of trips for the base year 1965, projections for 1980 and 1990 and a summary of the 30,000 home interview survey results.

The 291 analysis zones of the Bay Area have been integrated to form 30 zones in which the populated areas are evenly distributed about the population centroid. (see Figure 5.2). The populations of the zones vary from 12,000 up to 360,000 with an average value of about 150,000. Demographic data for these zones has been taken from the data tapes. The distances between zones are the actual road distances between the zone population centroids(see Table 5.1).

The trip matrices by mode are developed from the 30,000 home survey data. The necessary expansion factors to scale the data up to the full population level are contained in the data tapes. Because the data is a summary of the home survey, only approximately two-thirds of the 870 possible links are represented in the data set. Unlike the 291 x 291 BATSC asymmetric matrix of total trips, the matrices developed from the home survey data are very nearly symmetrical.

5.2 DEMOGRAPHIC VARIABLES

A brief analysis of the demographic variables has been made to determine the extent of their interrelationships. The data used for this analysis is the 30 x 30 travel matrix which was developed from the 291 x 291 BATSC travel matrix. This matrix is asymmetric in form, reflecting the characteristics of commute travel. The 30 zones used in the analysis are illustrated in Figure 5.2. Knowledge of the relationships between intraurban travel and demographic variables is most important in the demand modeling phase of the analysis, where the regression analysis could produce spurious results if collinear terms are included in the demand model. For instance, in Figure 5.3, the comparison between resident employed and the population of each zone demonstrates a very strong relationship. The employment rate is approximately 38% of the population.

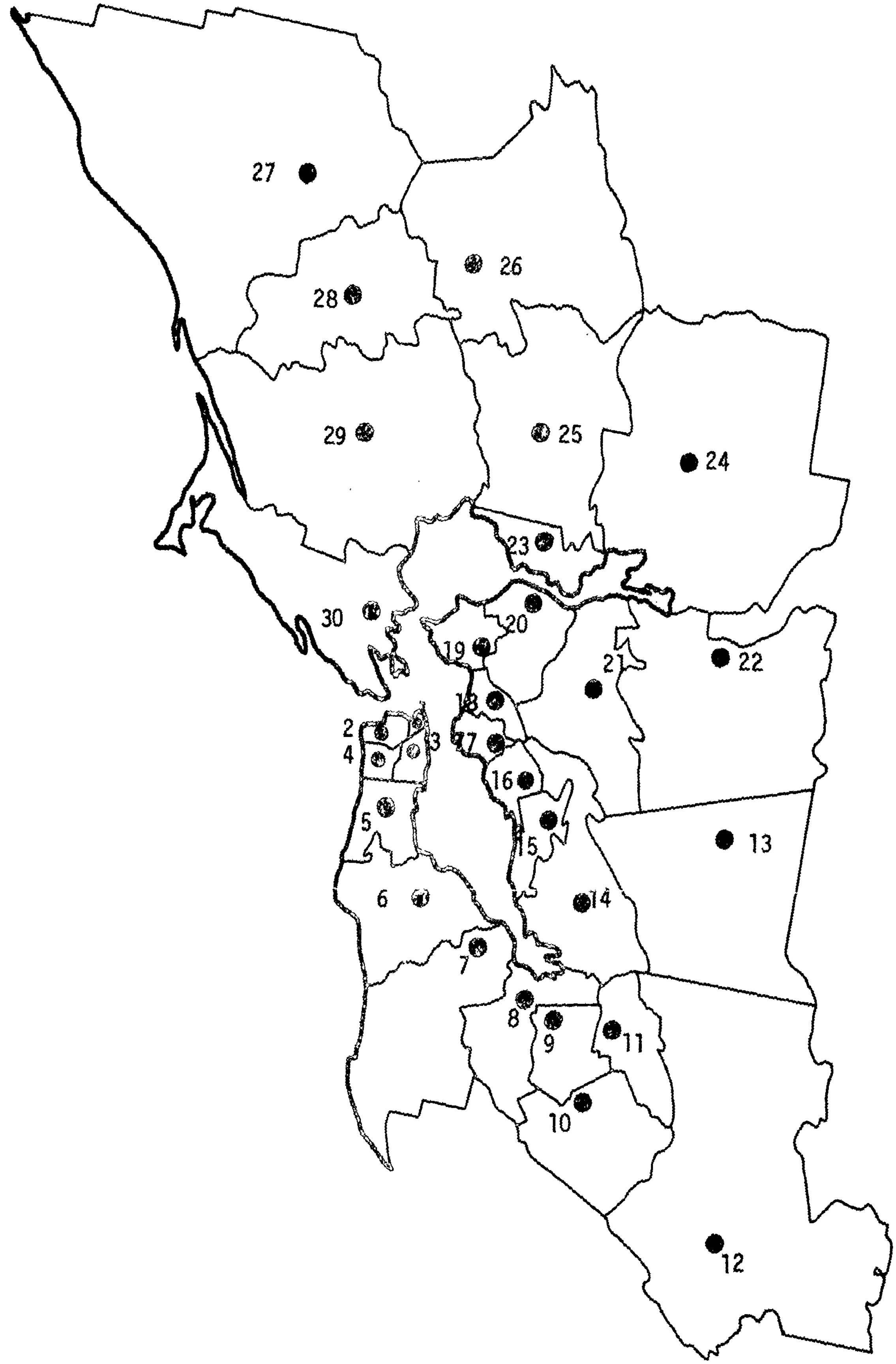


FIGURE 5.2. SAN FRANCISCO BAY AREA ZONES AND POPULATION CENTROIDS

TABLE 5.1

HIGHWAY DISTANCES BETWEEN BAY AREA SUPERZONE CENTROIDS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1																													
2	6.5																												
3	6.7	11.0																											
4	5.5	3.7	7.9																										
5	12.5	11.7	10.5	7.0																									
6	20.6	25.9	19.9	21.2	14.2																								
7	35.6	35.1	29.1	30.4	23.4	11.4																							
8	45.1	44.4	38.4	39.7	32.7	20.7	13.9																						
9	53.6	52.9	46.9	48.2	41.2	29.2	22.4	15.3																					
10	65.1	66.0	60.0	61.3	54.3	42.3	35.5	28.4	16.5																				
11	53.3	52.6	46.4	47.9	40.9	28.9	22.1	15.0	7.5	13.8																			
12	80.3	79.6	73.6	74.9	67.9	55.9	49.1	42.0	34.5	24.8	29.0																		
13	47.1	50.4	46.2	52.6	53.6	41.0	34.2	43.5	39.0	51.5	38.7	65.7																	
14	40.1	43.4	44.5	45.8	38.8	23.8	17.0	26.3	21.8	34.3	21.5	48.5	17.2																
15	26.3	29.6	25.4	31.8	32.8	25.2	27.0	36.3	35.0	46.8	33.0	61.0	21.2	18.1															
16	20.6	24.1	19.9	26.3	30.4	29.1	30.9	40.2	38.9	51.2	37.4	65.4	43.6	22.5	8.4														
17	15.0	18.3	14.1	20.5	24.6	33.5	35.3	44.6	43.3	55.6	41.8	69.8	48.0	26.9	14.2	7.8													
18	13.5	16.8	12.6	19.0	23.1	32.5	41.0	50.3	49.0	61.3	48.5	75.5	53.7	32.6	19.9	13.5	7.7												
19	17.7	21.0	16.6	23.2	27.3	36.7	45.2	54.5	53.2	65.6	52.7	79.7	57.9	36.8	24.1	17.7	11.9	7.6											
20	29.9	33.2	29.0	35.4	39.5	48.9	57.4	66.7	65.4	77.7	64.9	91.9	49.1	49.0	36.3	29.9	24.1	19.8	12.8										
21	30.9	34.2	30.0	36.4	40.5	49.9	59.1	63.3	58.8	77.1	63.3	91.3	30.1	48.4	30.0	29.3	23.5	22.0	24.6	19.0									
22	41.6	45.1	40.9	47.3	51.4	60.8	70.0	74.2	69.7	89.6	75.8	103.8	42.6	60.9	42.5	41.8	36.0	34.5	32.9	27.3	12.5								
23	33.8	37.1	32.9	39.3	43.4	52.8	61.3	70.6	69.3	81.5	68.7	95.7	52.9	52.8	40.1	33.7	27.9	23.6	16.6	3.8	22.8	31.1							
24	52.8	56.1	51.9	58.3	62.4	71.8	80.3	89.6	88.1	100.5	87.7	114.7	61.0	71.8	59.1	52.7	46.9	42.6	36.6	22.8	30.9	39.2	19.0						
25	48.7	52.0	47.8	54.2	58.3	67.7	76.2	85.5	84.2	96.4	83.6	108.9	66.1	67.7	55.0	48.6	42.8	36.8	31.5	22.3	37.7	46.0	19.1	24.8					
26	63.2	66.5	62.3	68.7	72.8	82.2	80.7	100.0	98.7	110.9	98.1	123.4	80.6	82.2	69.5	63.1	57.3	53.0	46.0	36.8	52.2	63.0	33.6	39.3	16.5				
27	71.7	69.2	76.2	72.9	79.9	94.1	103.3	112.6	121.1	116.3	103.5	142.2	110.0	104.0	88.9	83.9	76.1	73.8	65.8	72.3	87.7	98.5	69.1	74.8	52.0	35.5			
28	54.0	51.5	58.5	55.2	62.2	76.4	85.6	94.9	103.4	134.0	121.2	129.5	92.3	86.3	71.2	66.2	60.4	56.1	48.1	52.7	75.7	81.7	57.1	62.8	40.0	23.5	17.7		
29	40.5	38.0	45.0	41.7	48.7	62.9	72.1	81.4	89.9	102.8	90.0	116.0	76.8	71.8	57.7	52.7	46.9	42.6	34.6	39.2	59.9	68.2	41.3	57.4	48.2	40.0	34.2	16.5	
30	14.7	12.2	19.2	15.9	29.9	37.1	46.3	55.6	64.1	77.0	64.2	90.2	58.4	51.4	37.3	32.3	26.5	22.2	15.2	27.4	39.2	47.5	31.2	50.2	45.8	65.0	59.2	41.5	28.0

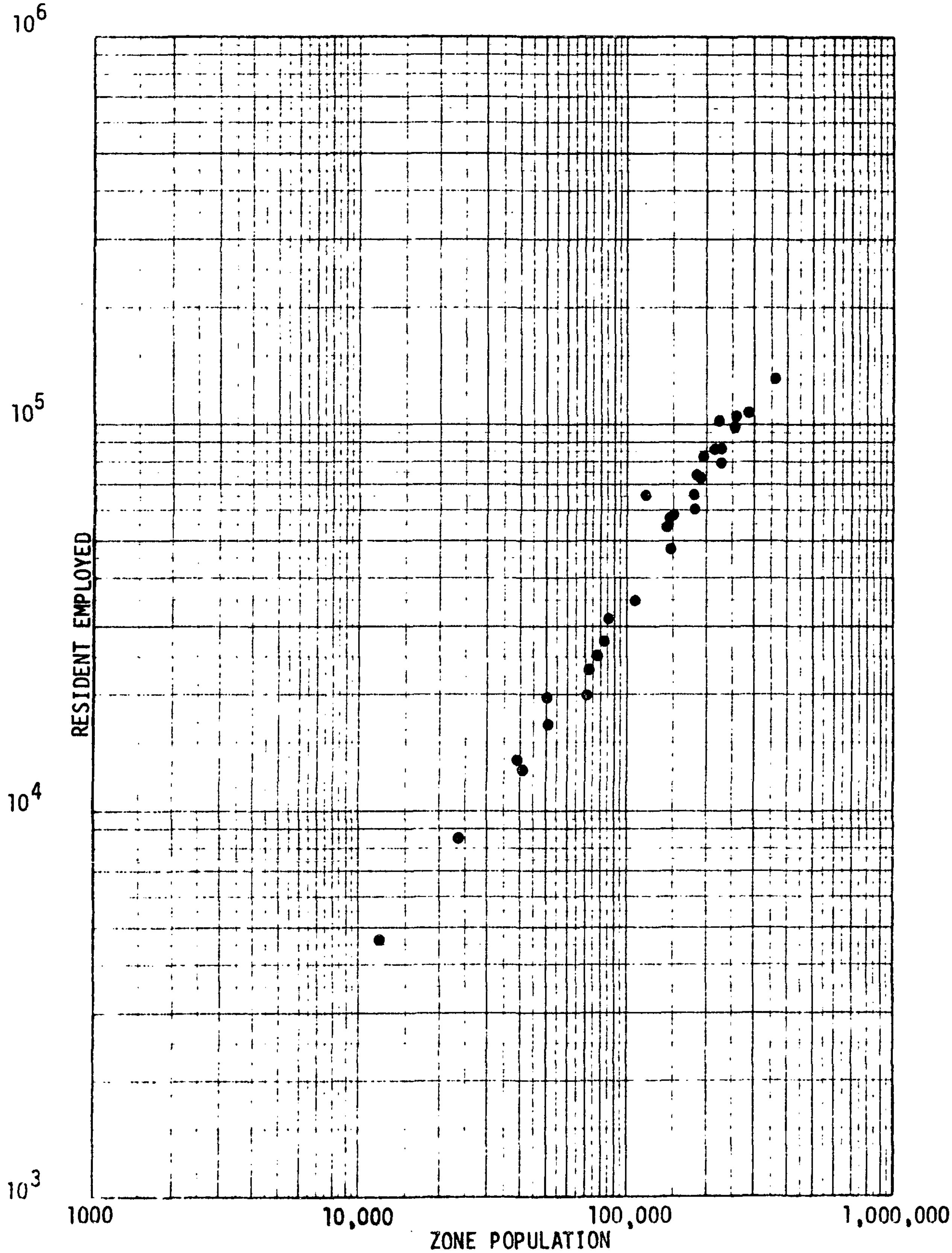


FIGURE 5.3: THE NUMBER OF EMPLOYED RESIDENTS IN EACH ZONE

Employment is subdivided into two categories, basic and population serving. Basic employment covers agriculture, mining, manufacturing, transportation, and federal and state government. Population serving employment covers construction, local transportation, utilities, retail trade, finance, services, and local government. The basic employment and population serving employment are compared with zone population in Figures 5.4 and 5.5 respectively. The basic employment of a zone does not correlate as strongly with zone population as population serving employment, which does appear to be a linear function of zone population.

When total zone employment is compared with zone population, Figure 5.6, the relationship between the two appears to break down at the higher population levels.

The zone employment fraction, E/P, has been compared with the other demographic variables, land area use and population density. In Figure 5.7, the zone employment fraction is compared with the ratio of business land area to residential land area, but no definite trend could be detected. Similarly, in Figure 5.8, the zone employment fraction is compared with the ratio of zone population to land area used, where the land area used includes residential, basic, and population serving land areas. Again, no correlation could be determined between the two parameters.

The basic conclusions of the study of demographic variables is that there is a strong correlation between zone resident employed and zone population. Also, a weaker correlation exists between the population serving employment of a zone and the zone population. Hence, any expression involving zone population need not include resident employed or population serving employment of the zone.

5.3 TRIP GENERATION FACTORS

The basic demand matrix for intraurban travel is asymmetric, reflecting the general flow of daily travel from the bedroom communities into the city for employment, commerce, and recreation. Those factors governing the generation of trips are analyzed here while the trip attraction factors are analyzed below. By this means, the factors which govern the imbalance in traffic flow will be identified and can be incorporated in the daily travel demand models.

The total trips generated in the 30 zones have been compared with zone population in Figure 5.9. Note that this data has been

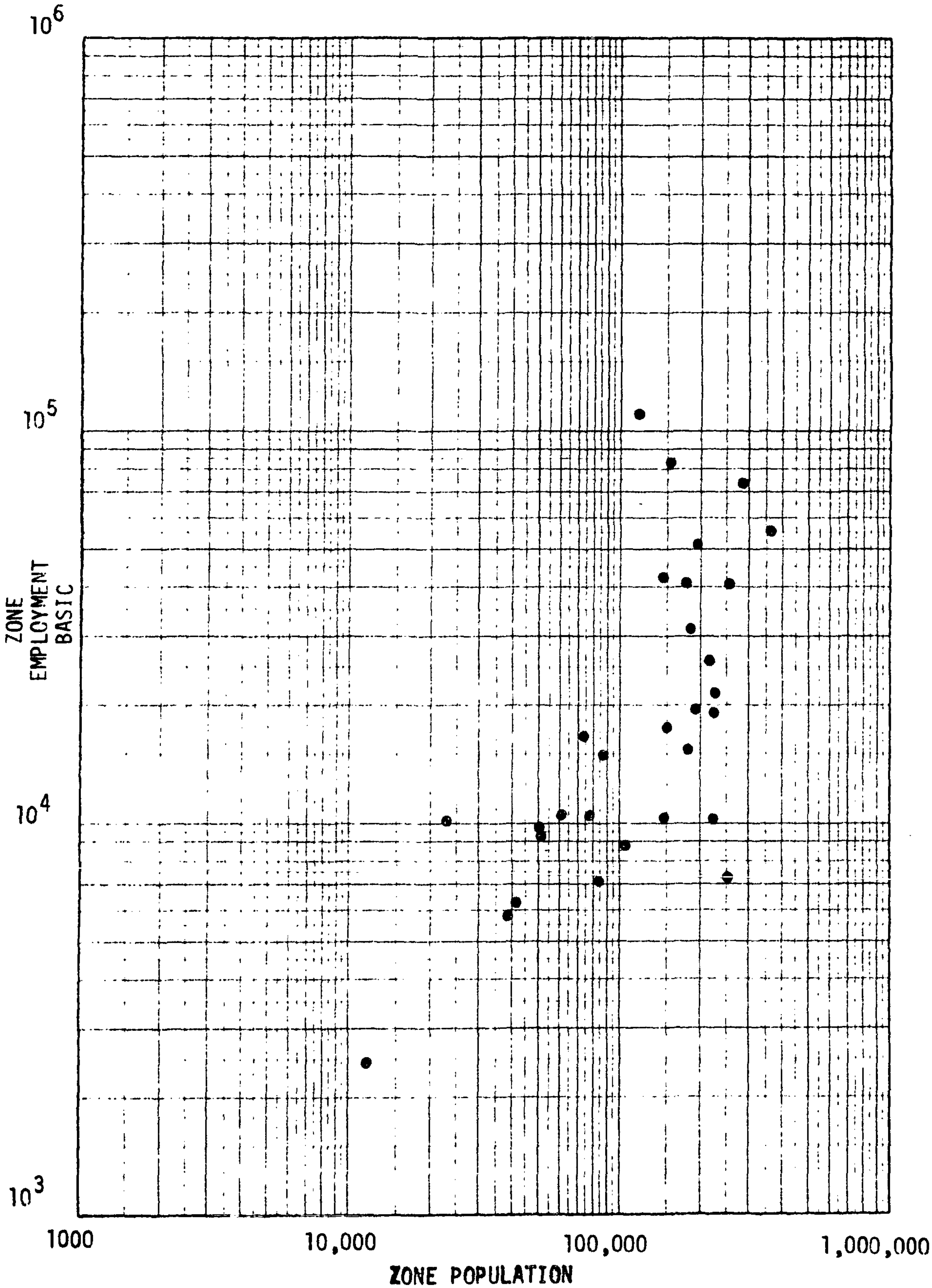


FIGURE 5.4

THE NUMBER OF PEOPLE EMPLOYED IN BASIC INDUSTRIES IN EACH ZONE

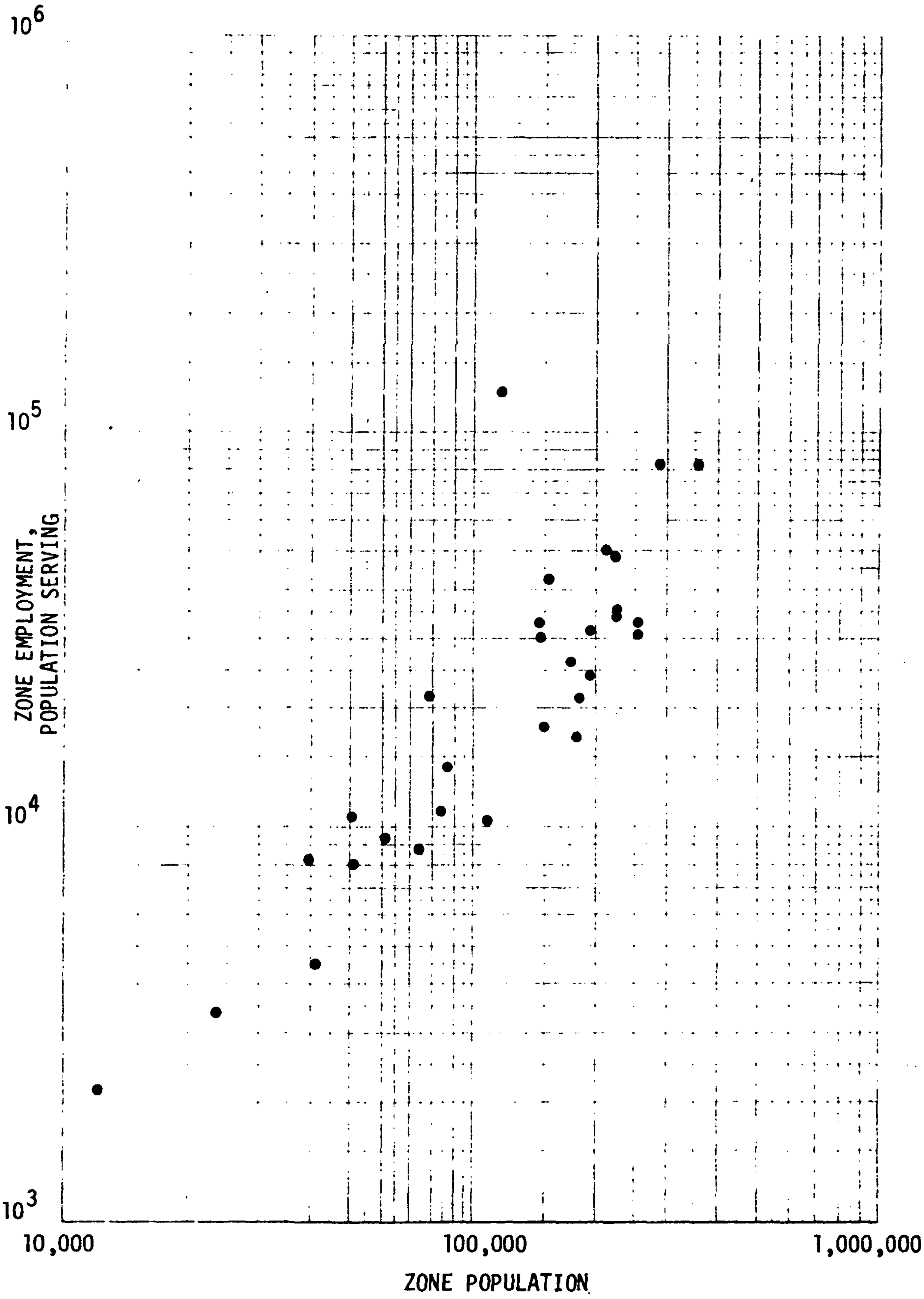


FIGURE 5.5: THE NUMBER OF PEOPLE EMPLOYED IN POPULATION SERVING INDUSTRIES IN EACH ZONE.

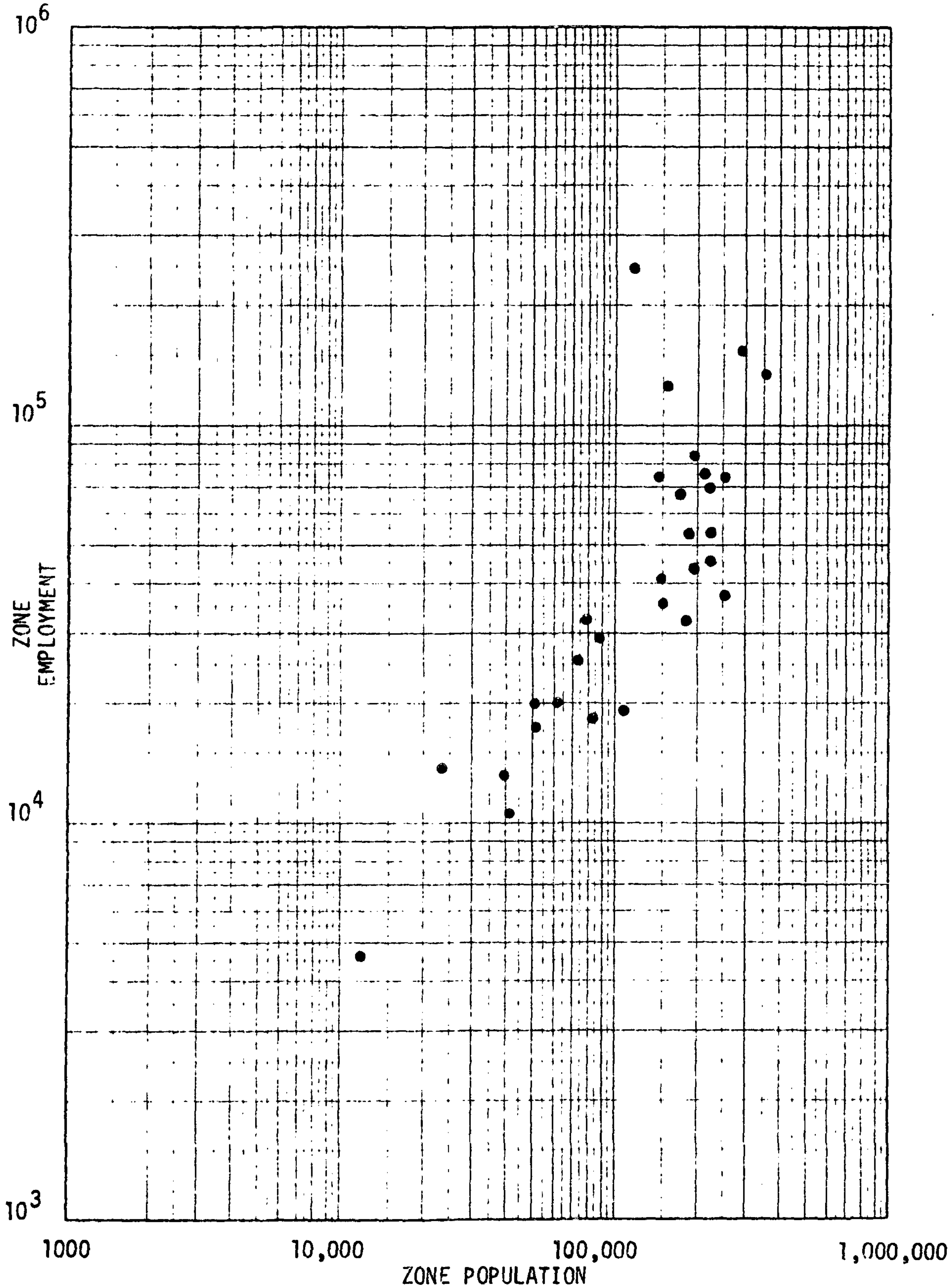


FIGURE 5.6: THE TOTAL NUMBER OF PEOPLE EMPLOYED IN EACH ZONE

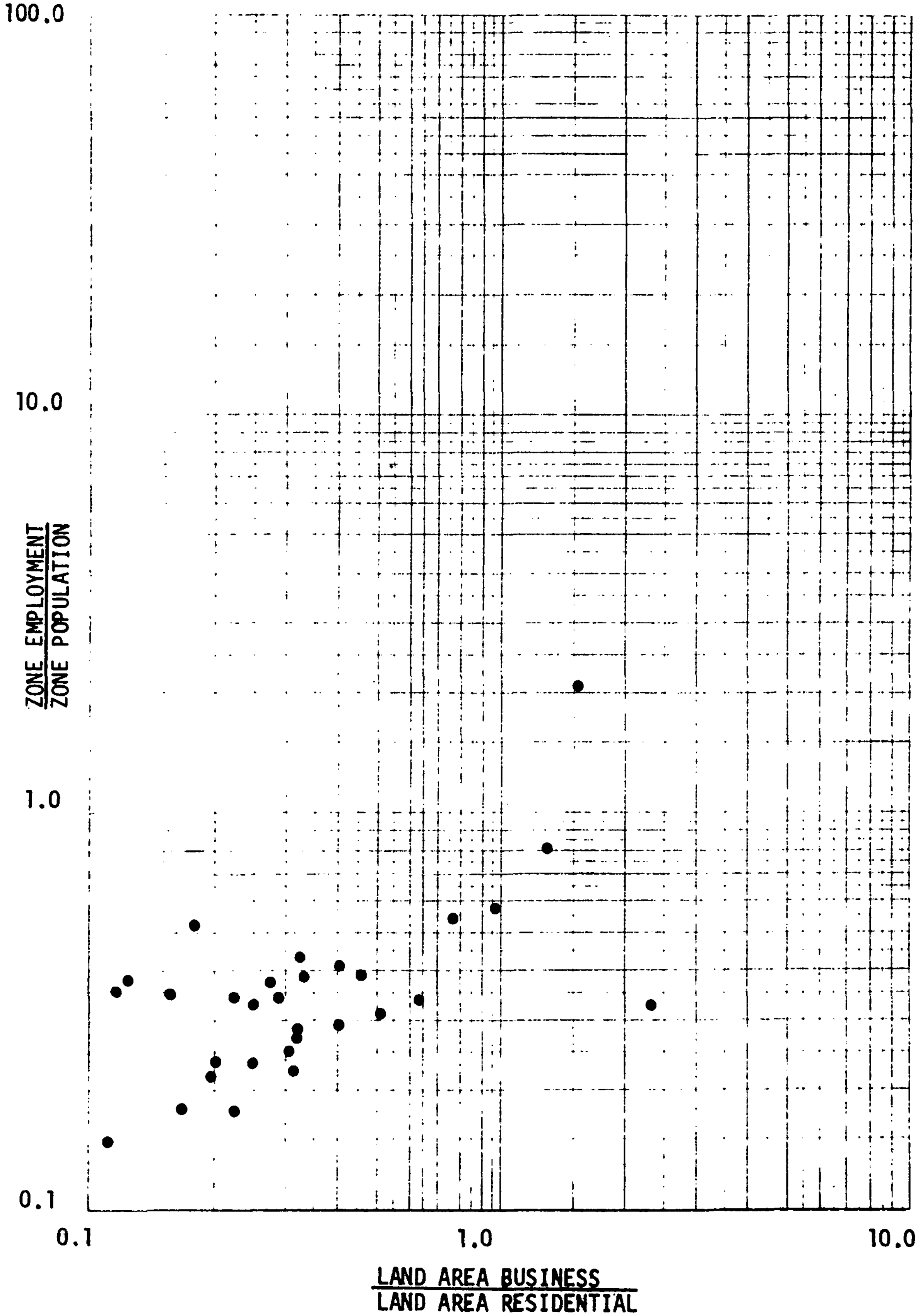


FIGURE 5.7: COMPARISON BETWEEN LAND USE AND EMPLOYMENT

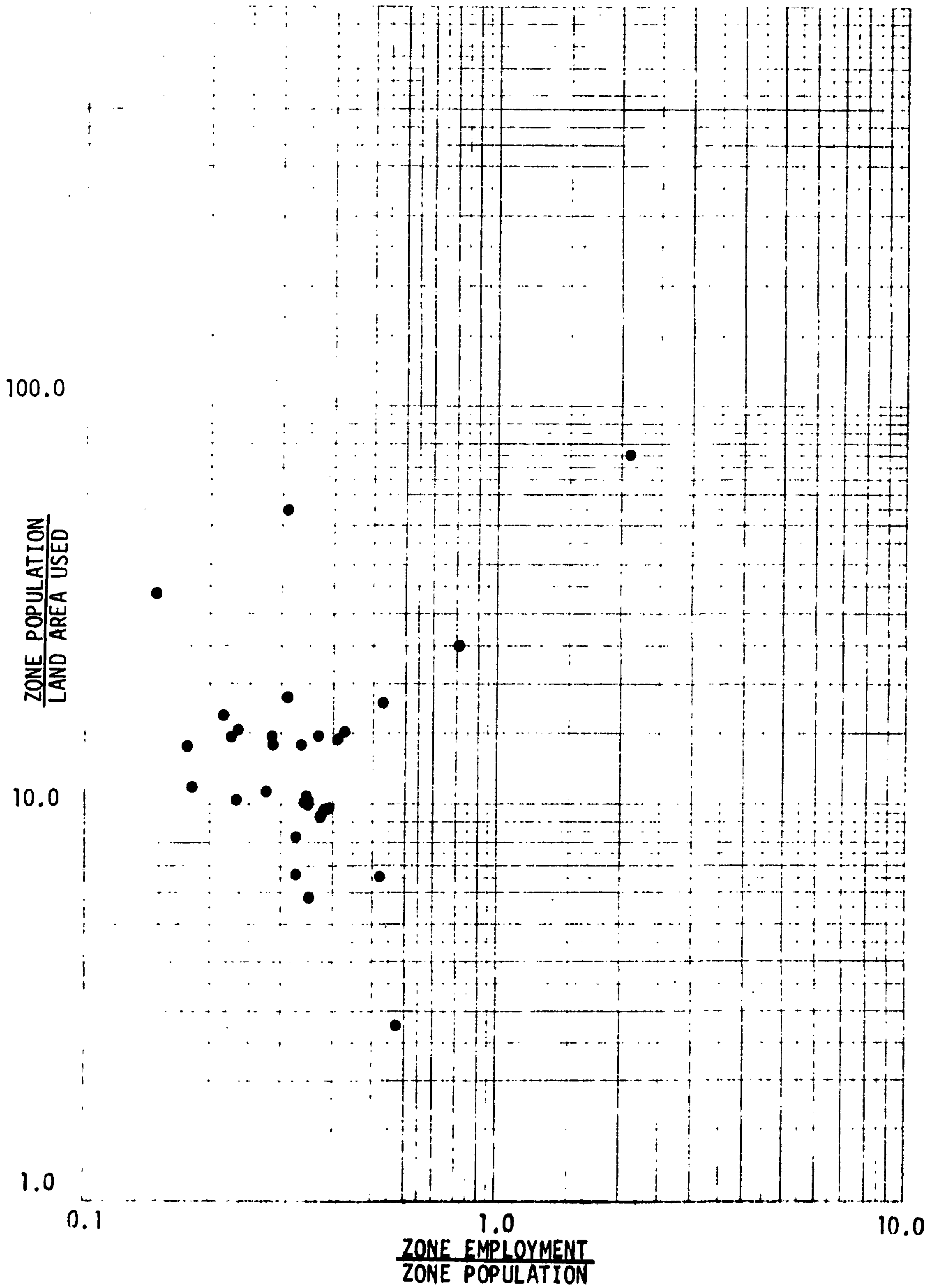


FIGURE 5.8
COMPARISON BETWEEN POPULATION DENSITY AND ZONAL EMPLOYMENT

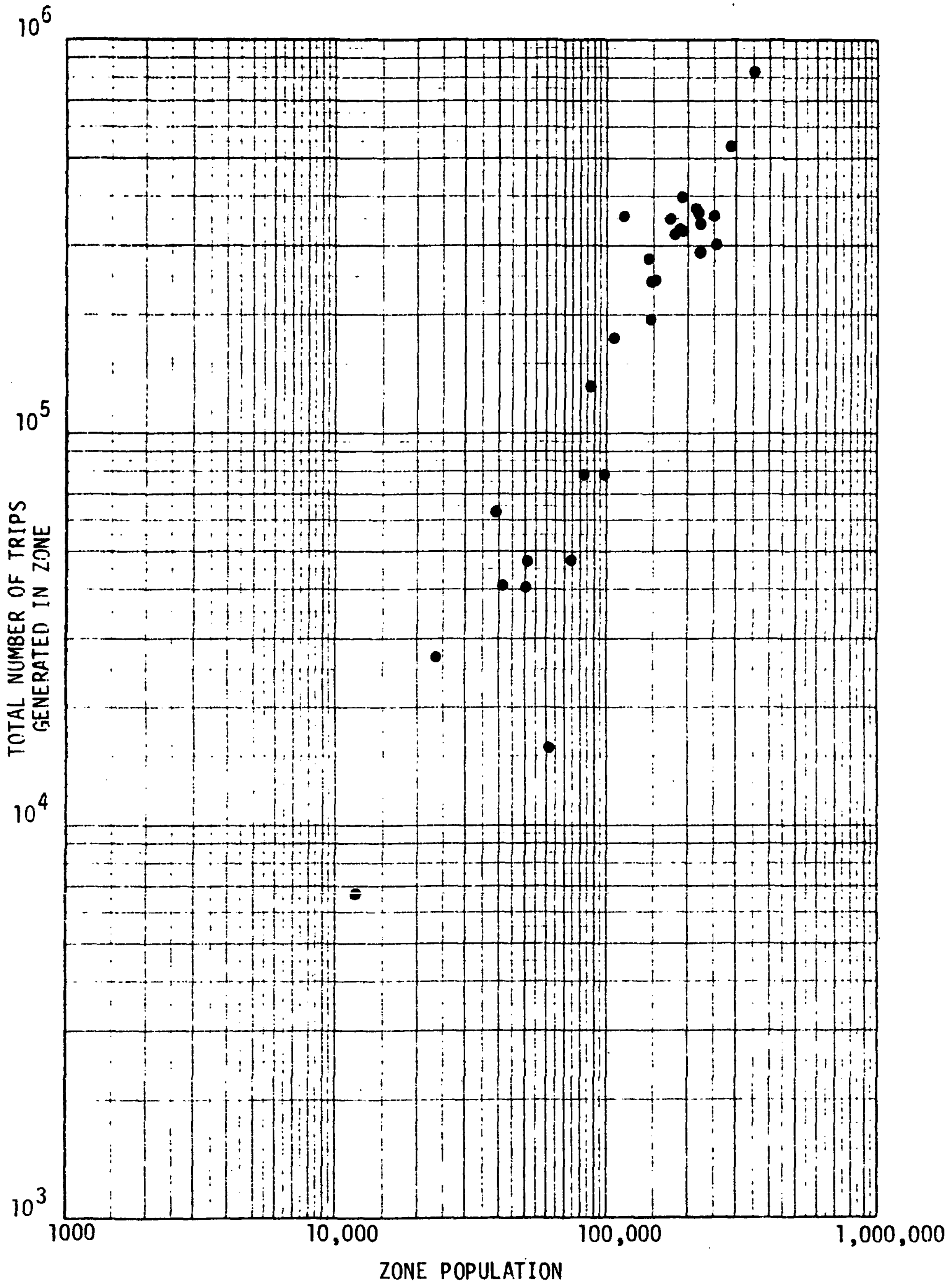


FIGURE 5.9: TOTAL TRIP GENERATION

obtained by integrating the interzone travel at the 291 zone level, and hence does not include the intrazone travel. The total daily trips generated in the San Francisco Bay Area by these means is 7.26 million. There is a strong correlation between the total trips generated and zone population. Interestingly, the one point which stands out as generating fewer trips (population 61,000) is zone 24, which borders on Sacramento. The travel between zone 24 and Sacramento is not included in the data set, and no doubt accounts for the major share of daily trips.

A similar comparison between the number of trips leaving a zone versus the zone population has been made in Figure 5.10. The correlation is strong and displays the fact that a demand model must include the population of the origin zone.

The correlation between zone employment and trip origins, Figure 5.11, is weak.

The use of the sum of zone population and employment to correlate with the number of trips leaving a zone is shown in Figure 5.12. The main characteristics of the data are essentially the same as those obtained by using population alone. The reason being that the zone population is generally two or three times greater than the zone employment and hence the scatter generated in the employment data is largely suppressed.

5.4 TRIP ATTRACTION FACTORS

The number of daily trips attracted to a zone from the remaining 29 zones in the San Francisco Bay Area have been compared with various demographic variables. Following the success of zone population as a means of predicting trip generations, zone population was used again to correlate with trip attractions; see Figures 5.13 and 5.14. The first plot attempted to find the log-log relationship between zone population and zone trip attractions. As will be noted in Figure 5.13 the relationship is non-linear with only a moderate degree of scatter in the data. The second plot, Figure 5.14, represents an attempt to find a log-linear relationship to describe the previously noted non-linear characteristics. However, none of the attempts uncovered a usable relationship and it was concluded that although zone population would exert some influence as a trip attraction factor, it would also be responsible for a large degree of scatter in the solution.

The correlation between zone employment and trip attractions, in Figure 5.15, is strong although the degree of scatter is fairly large. In order to determine the effect of the type of employment on trip attractions, the population serving employment and basic employment data are presented in Figures 5.16 and 5.17. It would appear from these two figures, that the basic employment is the greatest contributor to the scatter in the data, and that the best results could be obtained by using the population serving employment as the trip attraction factor.

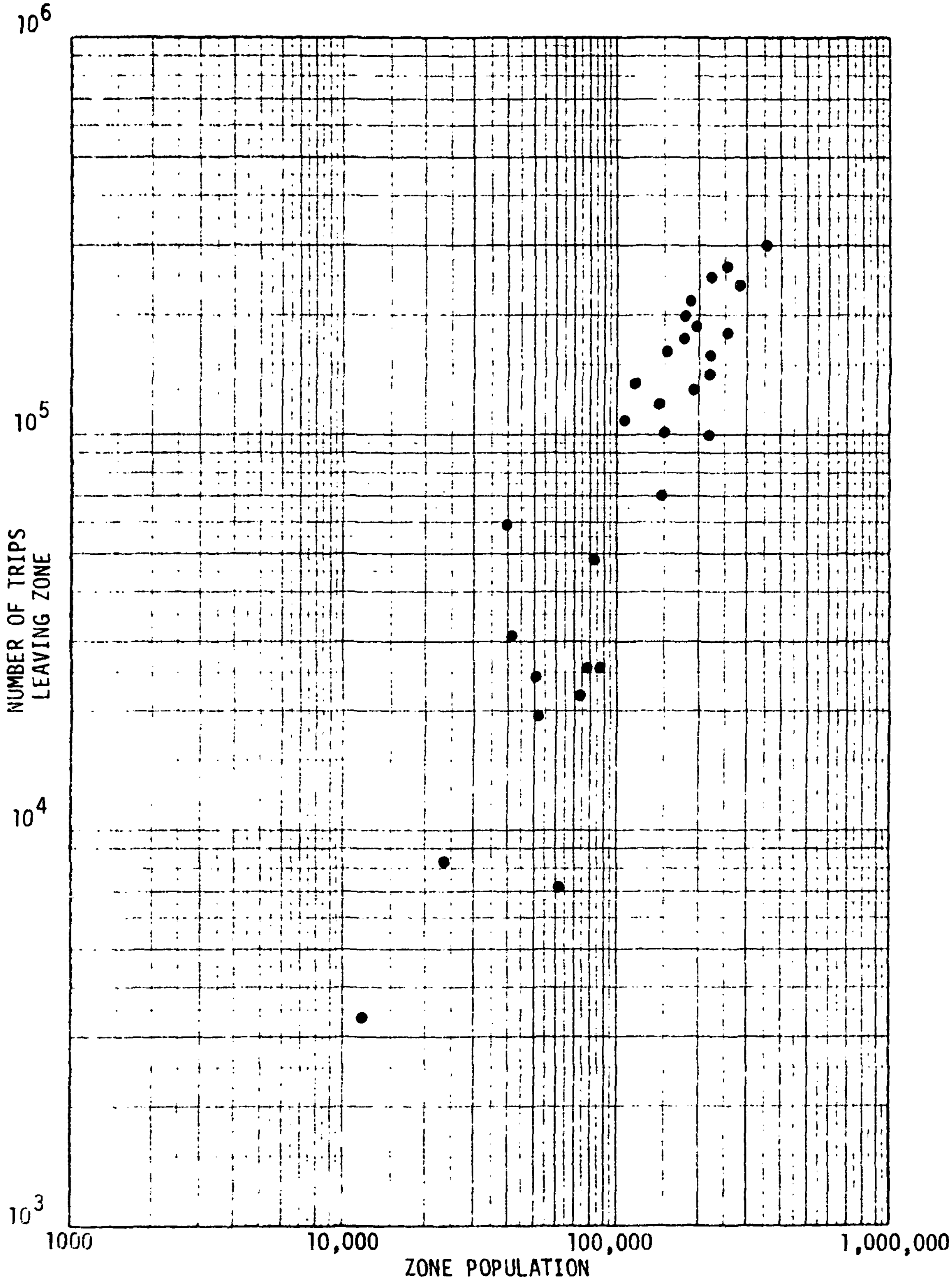


FIGURE 5.10: TRIP GENERATION FACTORS - ZONE POPULATION

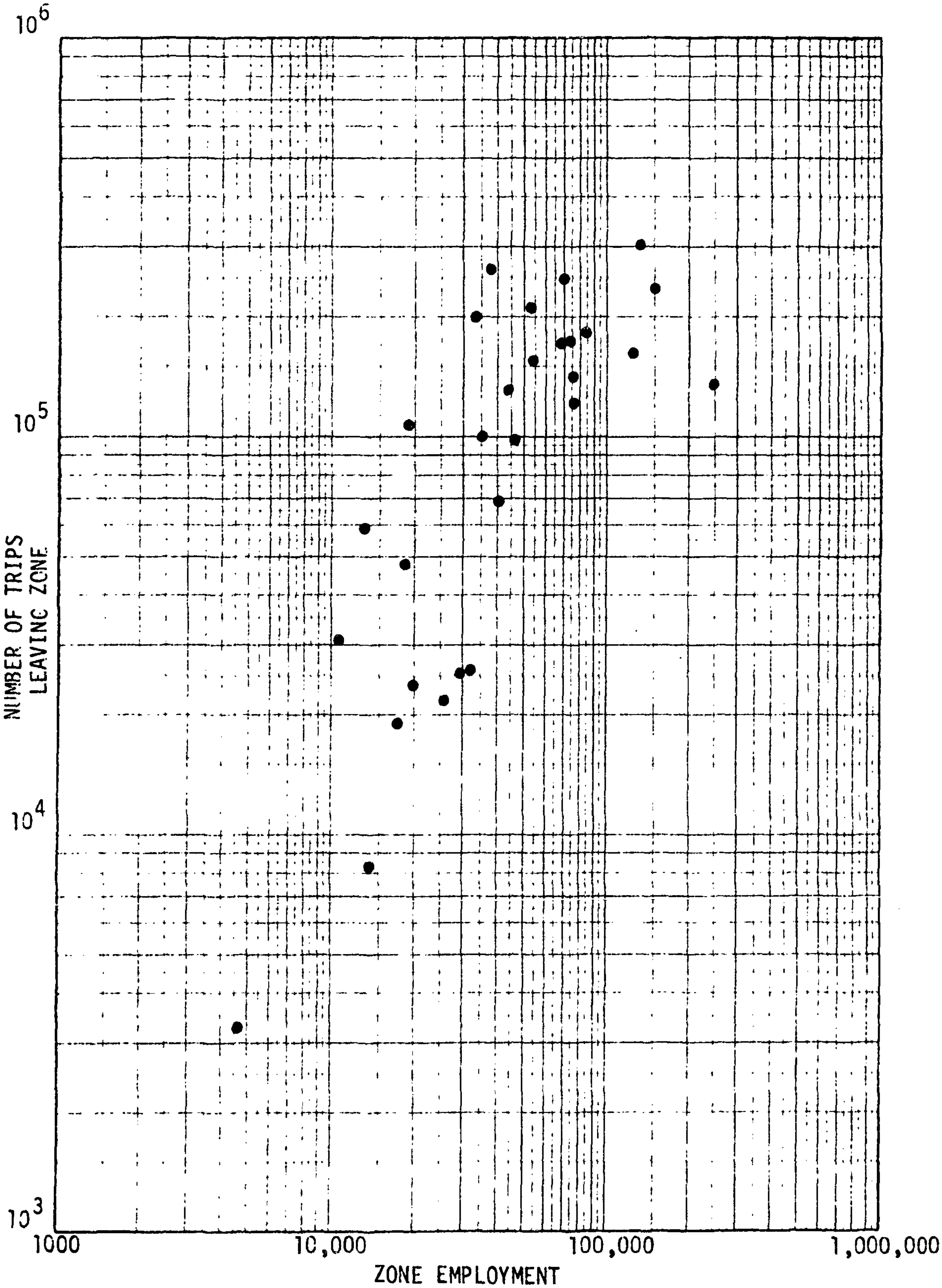


FIGURE 5.11: TRIP GENERATION FACTORS - ZONE EMPLOYMENT

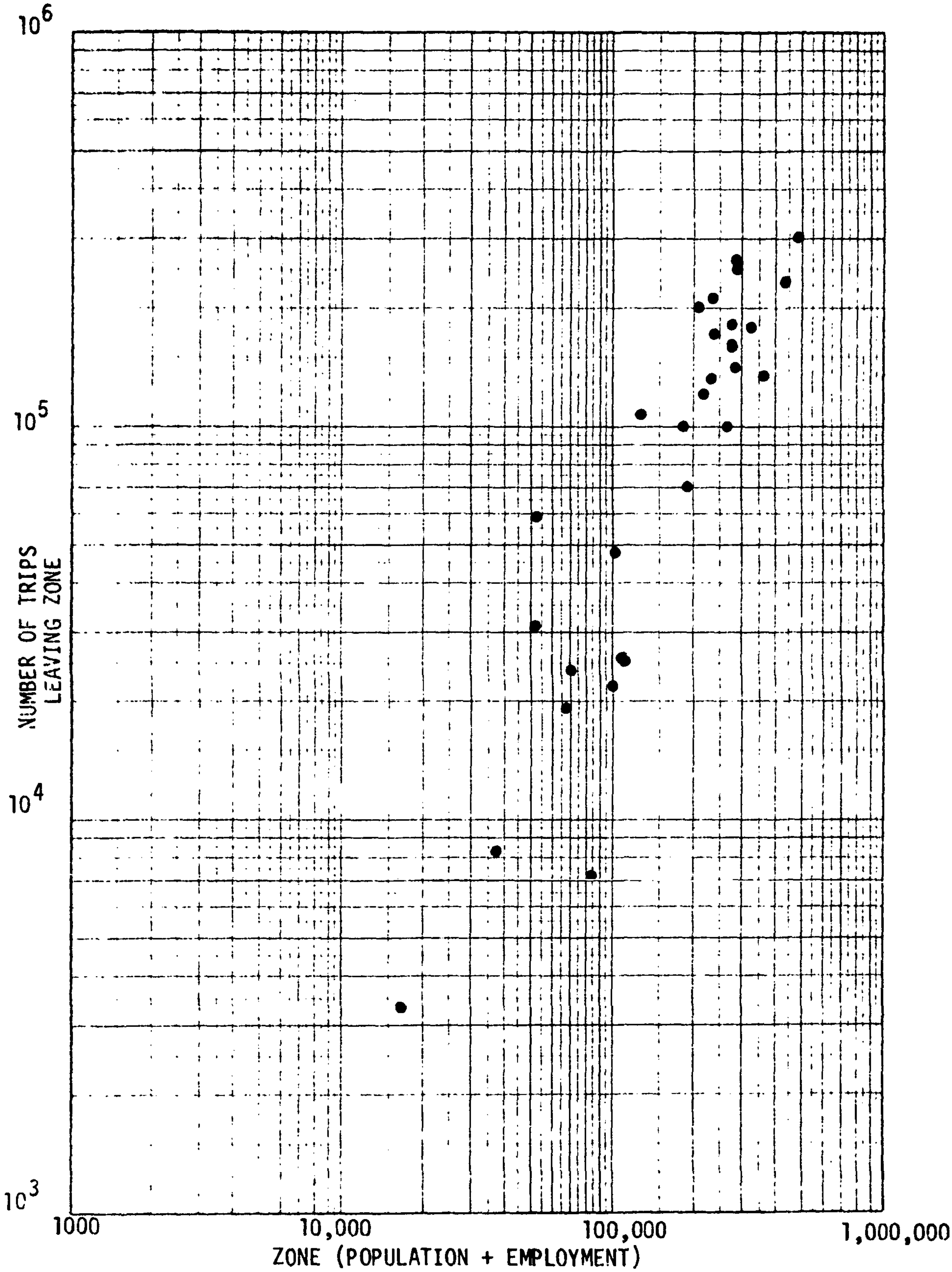


FIGURE 5.12
TRIP GENERATION FACTORS - SUM OF ZONE POPULATION AND EMPLOYMENT

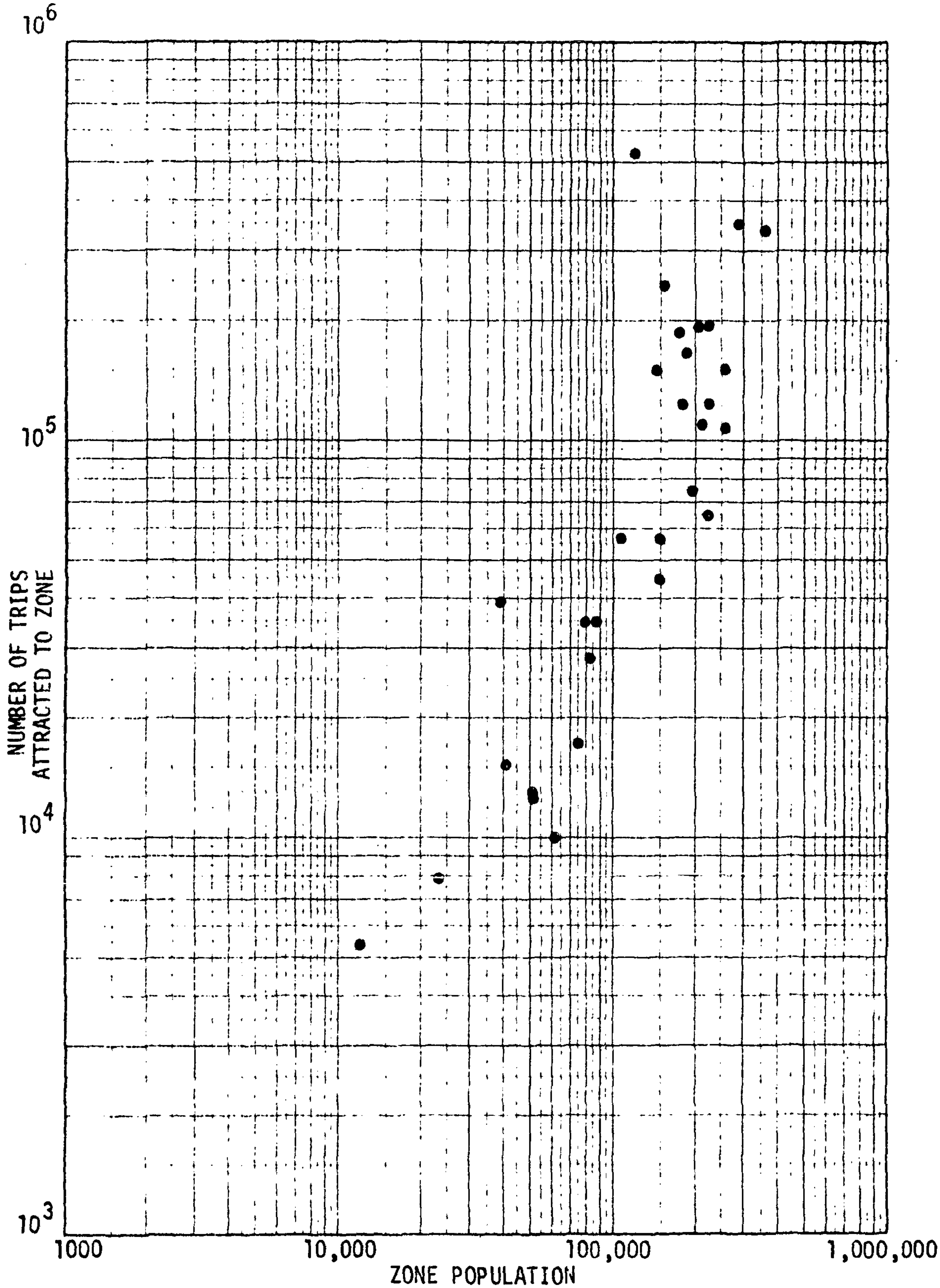


FIGURE 5.13
TRIP ATTRACTION FACTORS - ZONE POPULATION

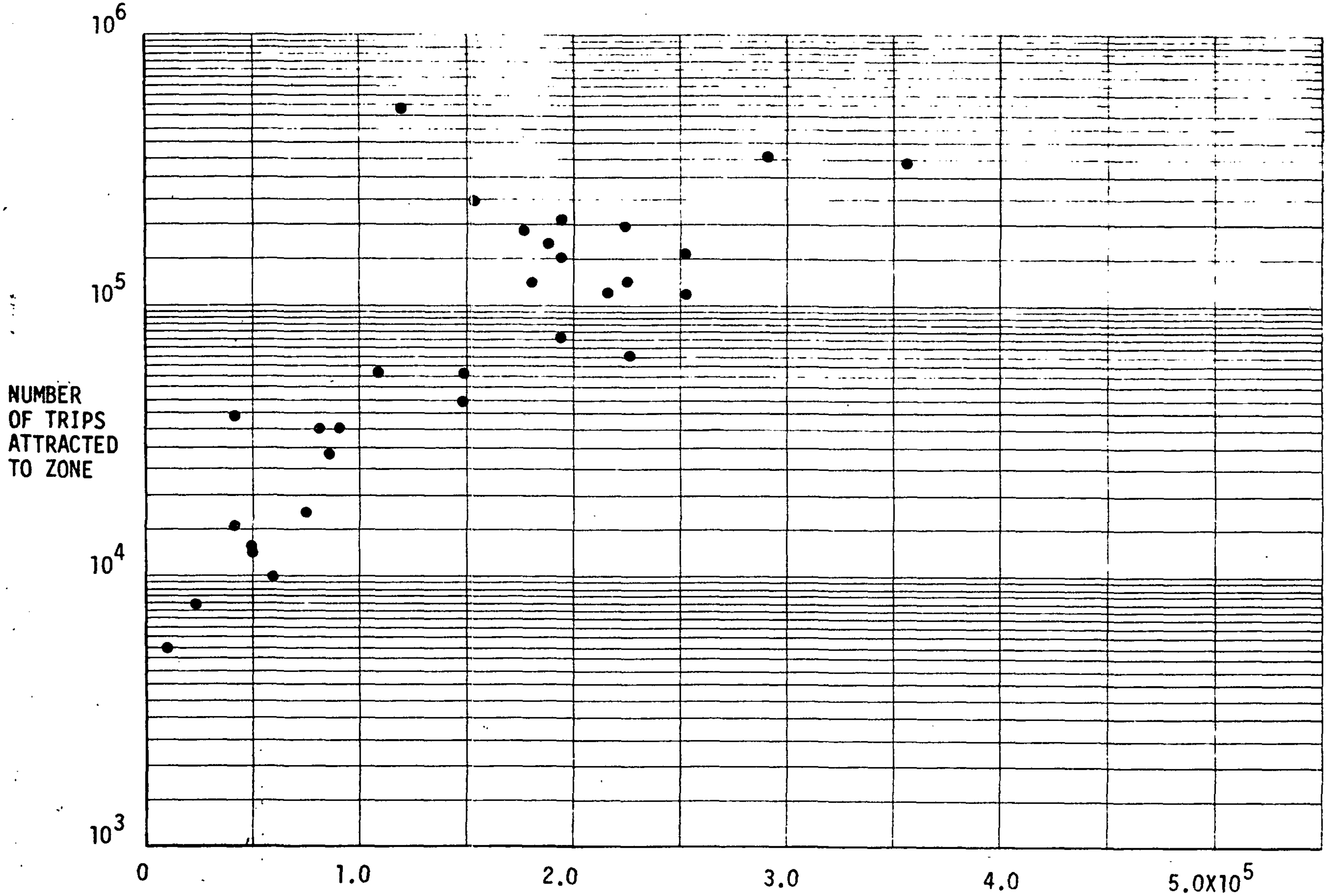


FIGURE 5.14: TRIP ATTRACTION FACTORS - ZONE POPULATION

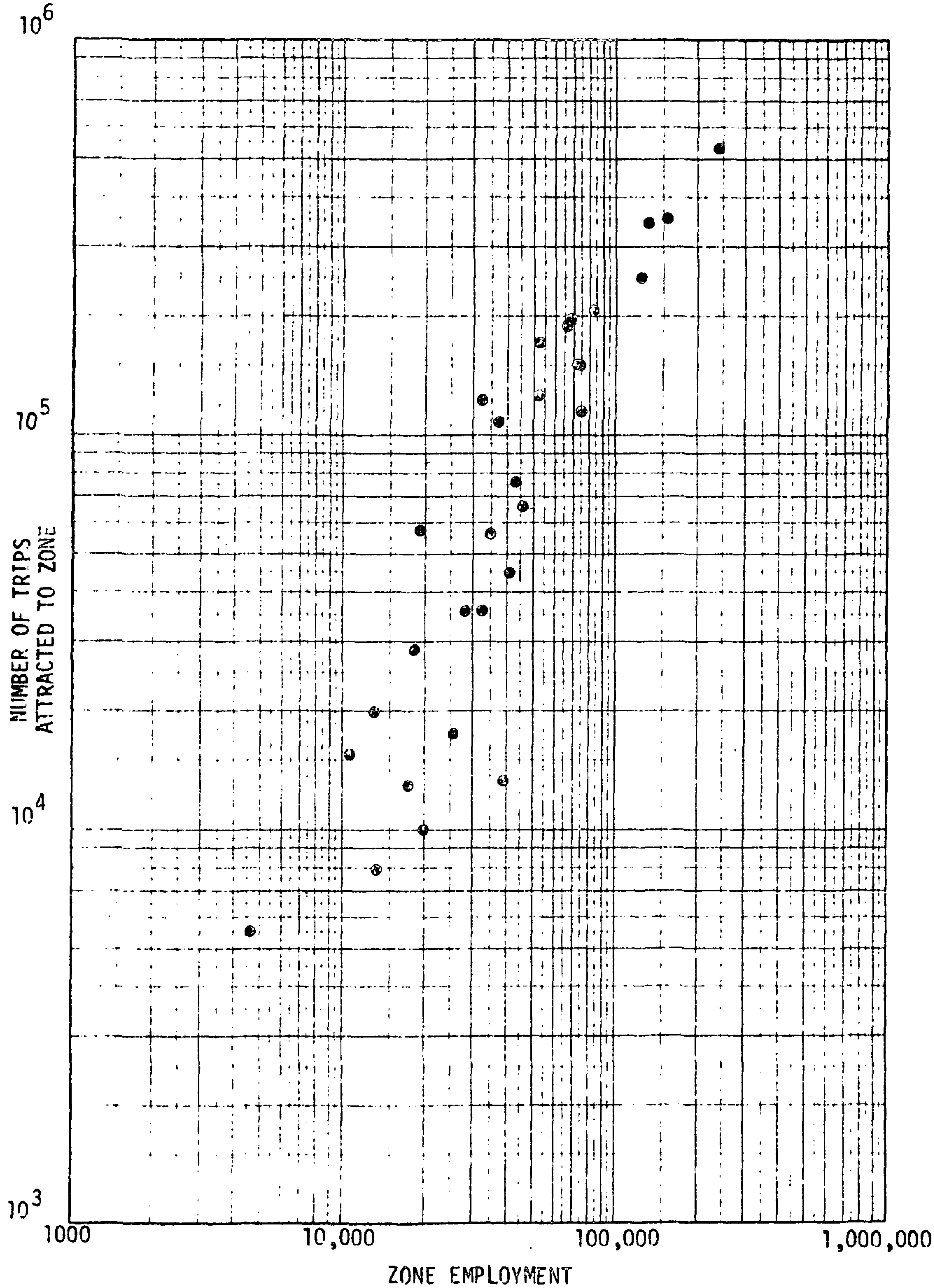


FIGURE 5.15
TRIP ATTRACTION FACTORS - ZONE EMPLOYMENT

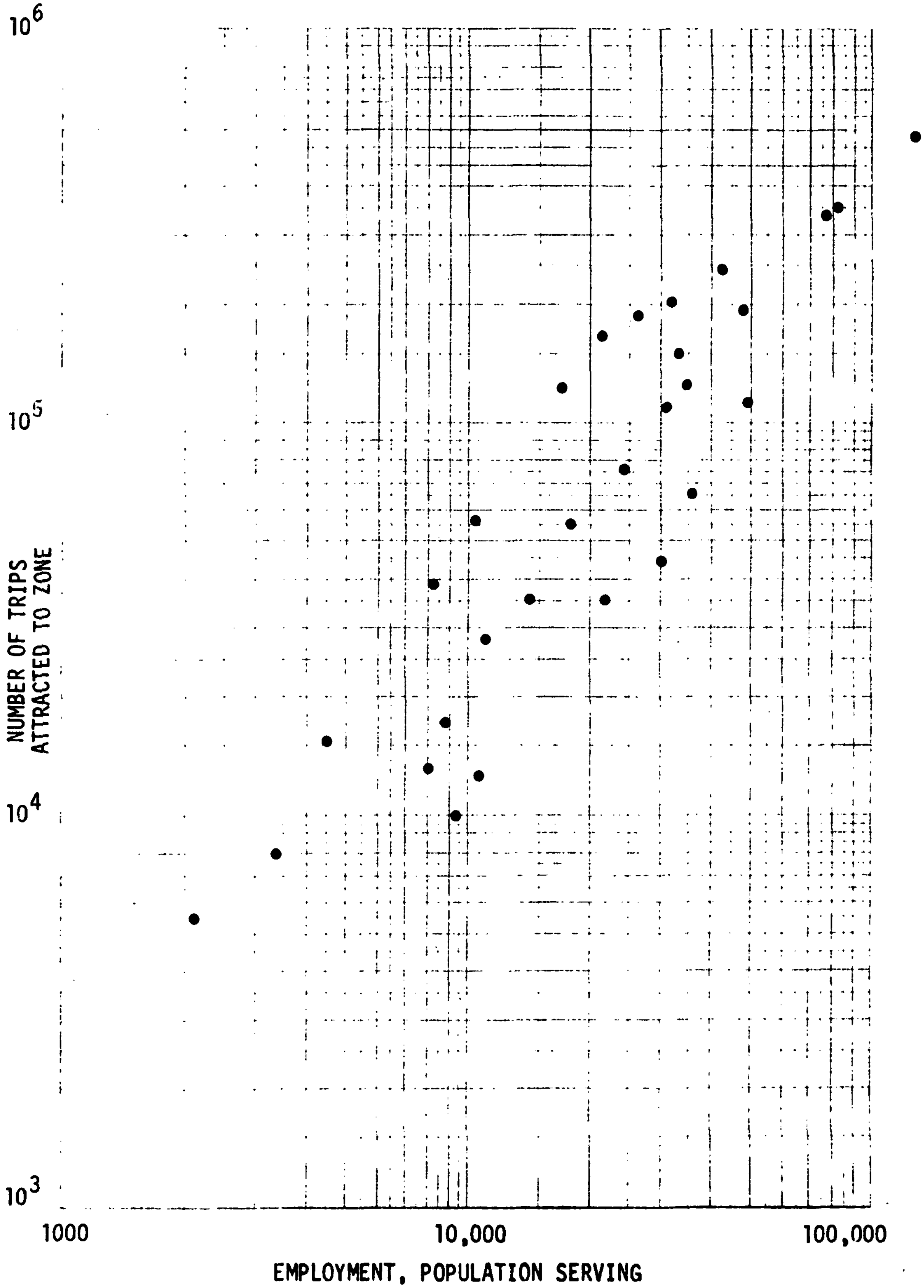


FIGURE 5.16
TRIP ATTRACTION FACTORS - ZONE POPULATION SERVING EMPLOYMENT

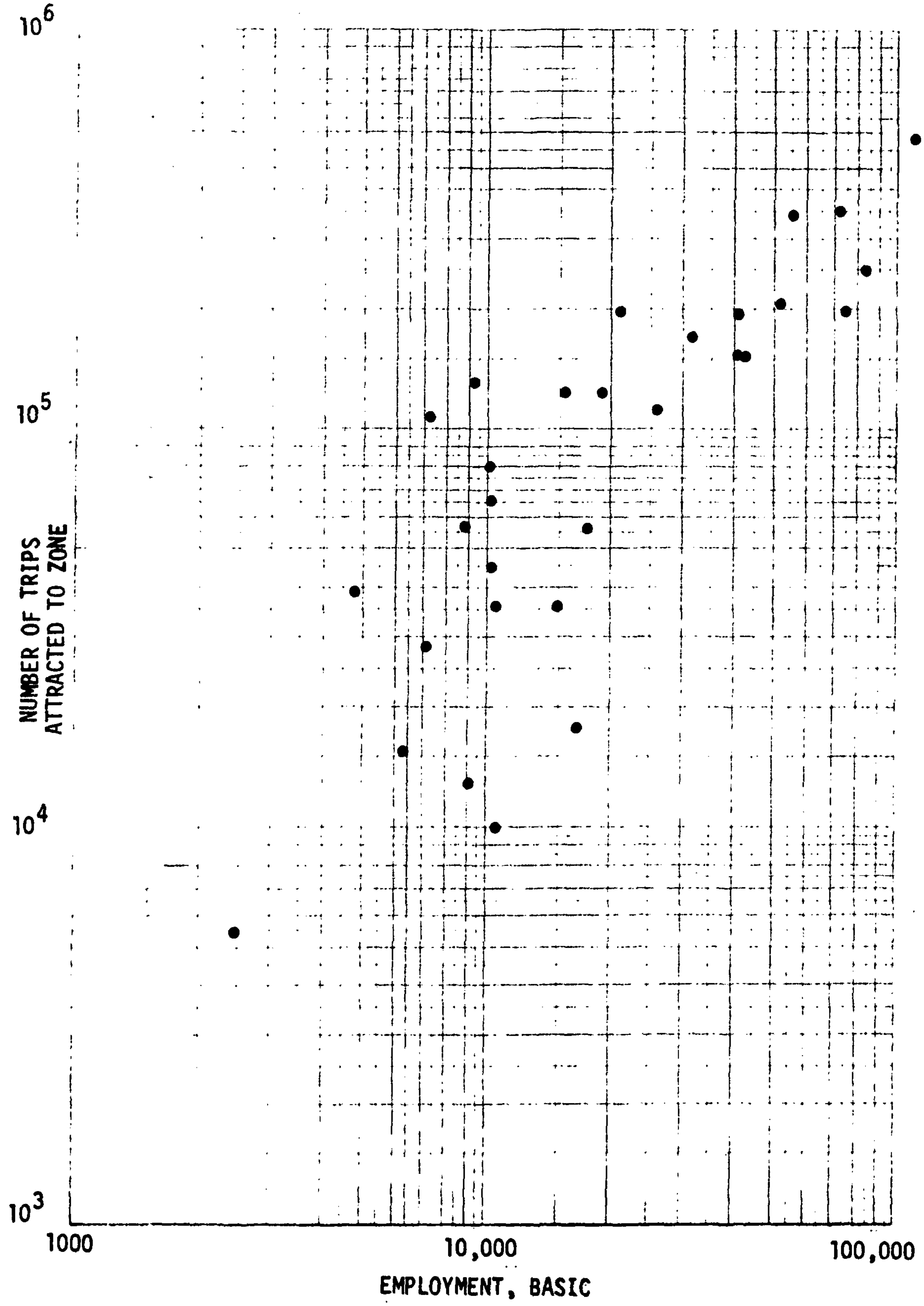


FIGURE 5.17
TRIP ATTRACTION FACTORS - ZONE BASIC EMPLOYMENT

A further comparison is made, this time, between trip attractions and the sum of population and employment for the zone, Figure 5.18. The correlation is strong, with much of the scatter evident in Figure 5.13 being scaled down.

The trip generation factors have been found to differ from the trip attraction factors and the result of the above analysis is that the daily travel demand model should be of the form:

$$D_{ij} = f(P_i, E_{psj})$$

$$\text{or} \quad D_{ij} = f[P_i, (P_j + E_j)]$$

The above models have the desirable characteristics of being capable of producing asymmetric demand matrices.

5.5 TRIP DISTRIBUTION

The trip distribution combines both the total generalized demand model and mode split. In combining the mode split analysis at this stage, the travel matrix used must contain modal data, i.e. travel matrices for each mode being analysed. The data source for these matrices is the BATSC 30000 home survey data with expansion factors to raise the travel data level to the total population travel level. These modal travel matrices are essentially symmetric in nature and consequently the regression analysis will be incapable of developing models of the asymmetric form suggested above. But the insights gained in the analysis of the trip generation and attraction factors are used as a guide in understanding the results of the regression analysis.

The initial step in data preparation was to devise time-distance relationships for each mode and to test for bridge penalties. Two data sets were used independently in the analysis; these were the BATSC 30000 home survey data and the preference survey data. The results of the BATSC travel data is presented in Figure 5.19, where the data has been extrapolated beyond the data limits at approximately 60 miles. The data displays a nine minute bridge penalty for the auto and also a slightly different average speed, 55.6 mph and 58 mph.

The time-distance relationships for the bus and train were essentially the same. However, due to the small data sample for the train, it was necessary to combine both bus and train data sets, making it impossible to separate any small differences that

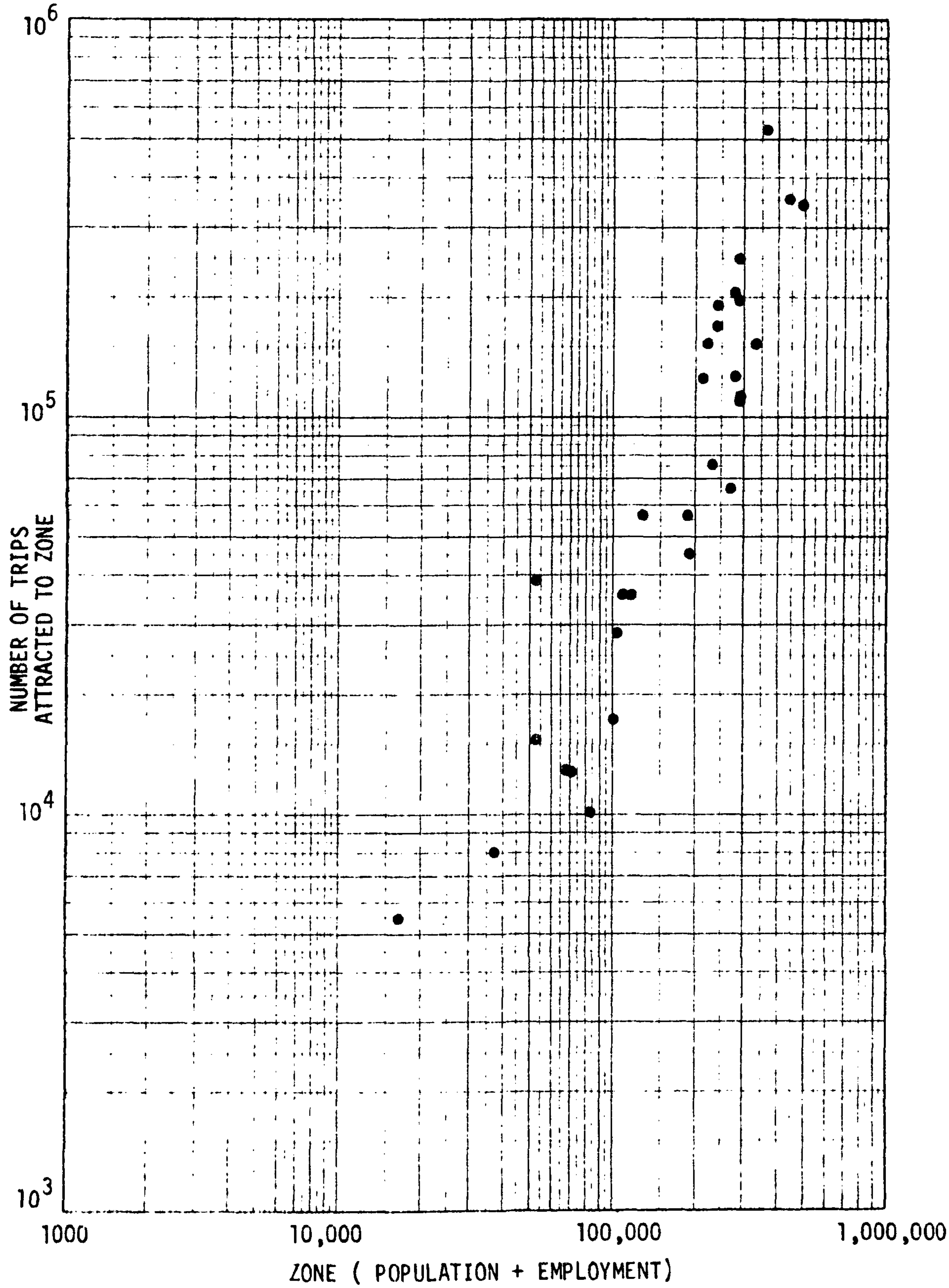


FIGURE 5.18
TRIP ATTRACTION FACTORS - SUM OF ZONE POPULATION AND EMPLOYMENT

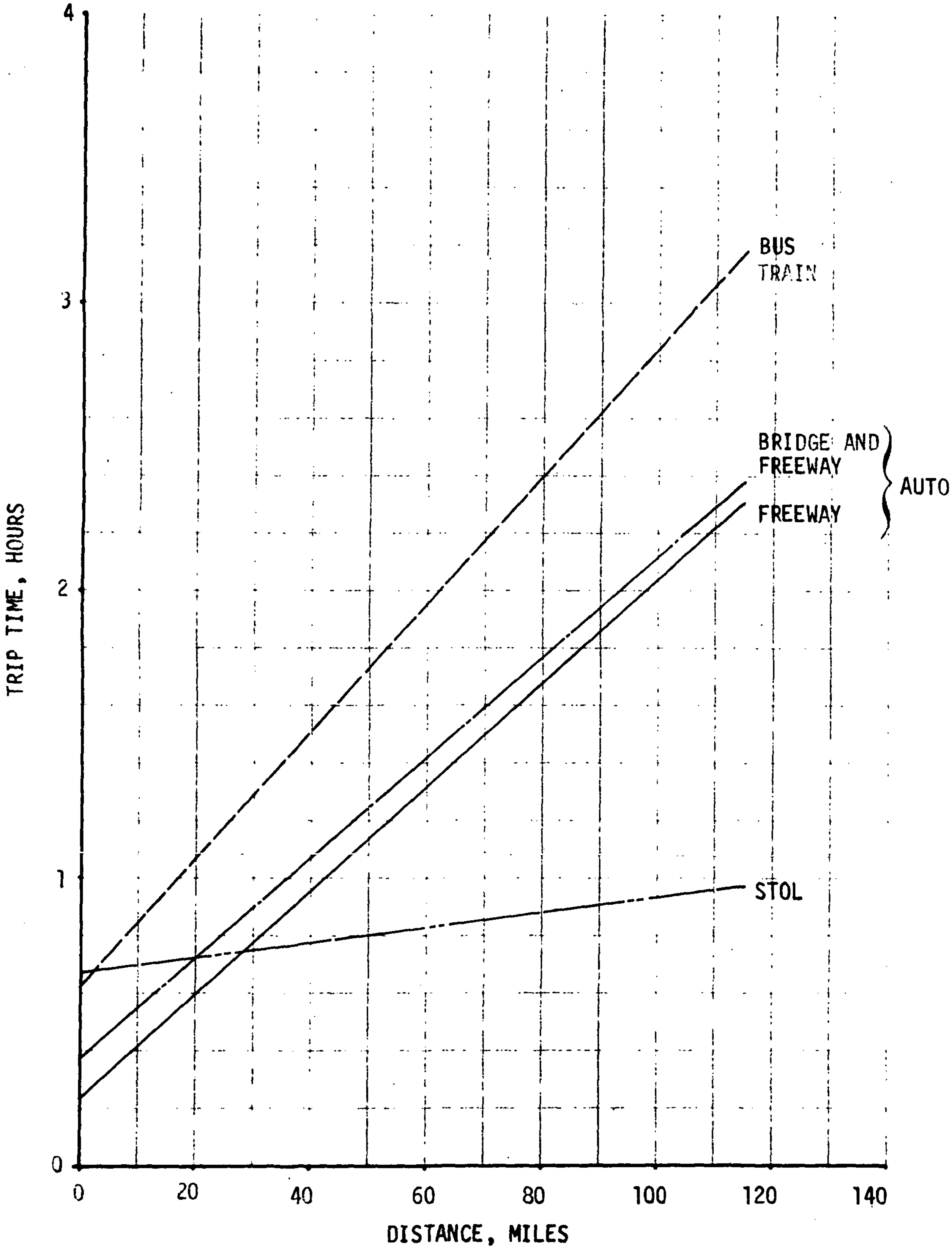


FIGURE 5.19: TIME-DISTANCE RELATIONSHIPS

might exist. The preference survey gave curious results with excessively high average speeds. This may have been due to non-linearity in the data set, but it was considered to be too unreliable for use.

Superimposed on the BATSC time-distance relationship of Figure 5.19 is the estimated data for the STOL airplane. The data was generated by using the intercept time value of the bus and rail curve, plus the block time for the STOL airplane as presented in Reference 1.

The cost-distance relationships for each mode were obtained from the preference survey results using regression analysis; see Figure 5.20. The auto costs are seen to differ widely in per mile cost depending on whether a bridge penalty was involved or not. The essential problem here is the wide scatter associated with perceived auto cost data, which varied nearly uniformly from zero to 30 cents per mile.

The demand model used in the step-wise regression analysis is of the abstract form; where demand is expressed as a function of the multiplicative combination of variables, that is

$$D_{ijk} = K \prod_{\ell=1}^{q} V(i,j,k)_{\ell}^{a_{\ell}}$$

where the variables, V(i,j,k) are;

P_i = Population at origin zone i ∿ 1,000's

P_j = Population at destination zone j ∿ 1,000's

E_i = Employment at i ∿ 1,000's

E_j = Employment at j ∿ 1,000's

E_{psi} = Population serving employment at i ∿ 1,000's

E_{psj} = Population serving employment at j ∿ 1,000's

NC_i = Number of automobiles at i

NC_j = Number of automobiles at j

I_i = Median household income at i ∿ dollars

I_j = Median household income at j ∿ dollars

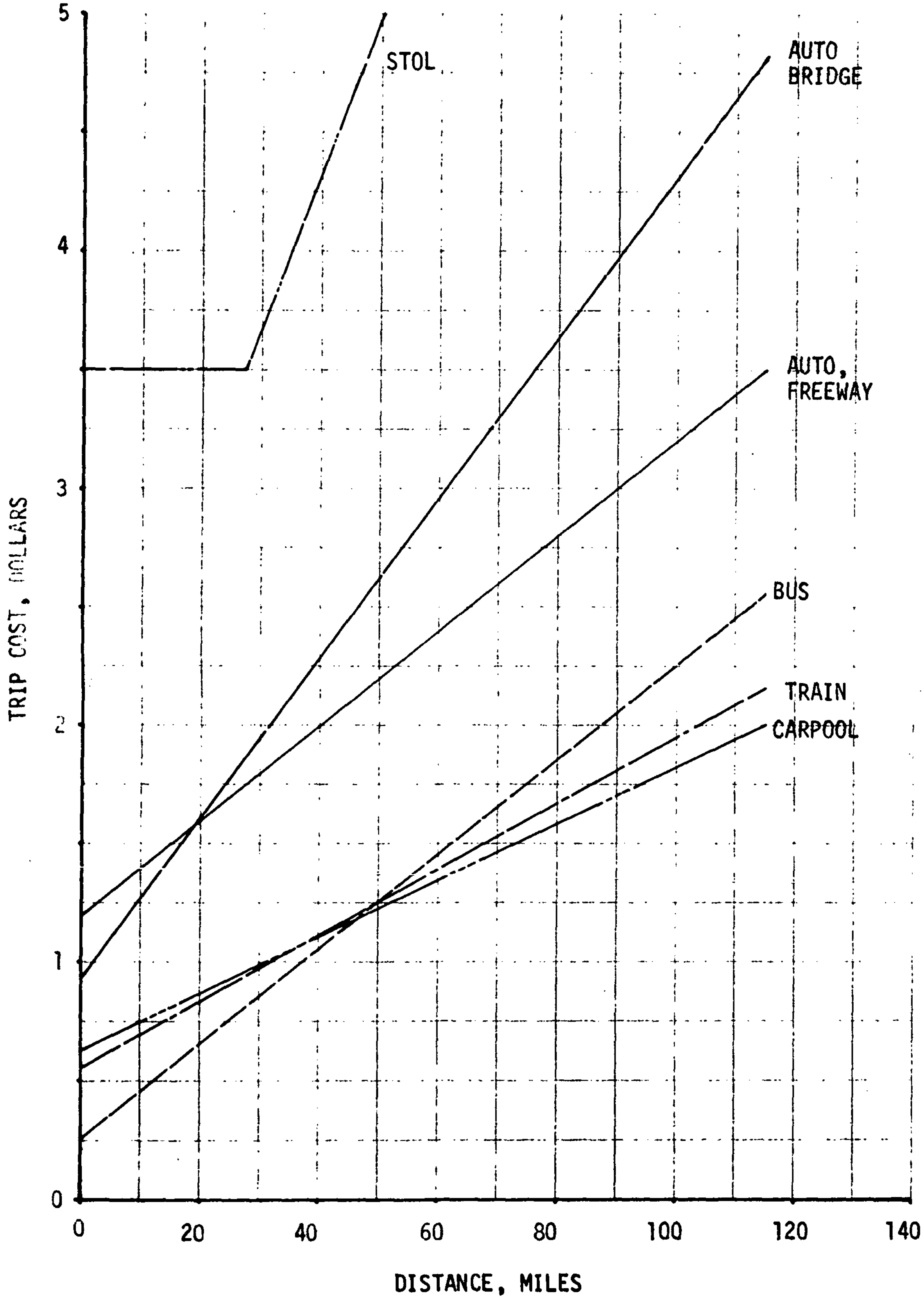


FIGURE 5.20: COST-DISTANCE RELATIONSHIPS

$\bar{I}_{ij}$ = Population weighted median income in zone i and zone j $\sim$ dollars

T_{bij} = Best (least) time between zone i and zone j $\sim$ minutes

$T_{rijk} = \frac{T_{ijk}}{T_{bij}}$ = relative time of mode k between zone i and zone j

C_{bij} = Best (least) cost between zone i and zone j $\sim$ cents

$C_{rijk} = \frac{C_{ijk}}{C_{bij}}$ = relative cost of mode k between zone i and zone j

N_{mij} = Number of modes available between zone i and zone j

In order to permit the use of least squares regression analysis, the generalized demand model was log-linearized, so that;

$$\ell n\, D_{ijk} = \ell n\, K + \sum_{\ell=1}^{q} a_{\ell}\, \ell n\, (V_{ijk})_{\ell}$$

Several combinations of the variables were selected for trial and the results of those displaying the better statistical solutions are presented in Table 5.2.

The coefficients of population P_i and P_j are always positive and generally statistically significant, i.e., t > 1.645 at the 5% level. The coefficients of employment E_i and E_j are always positive and statistically significant. These are the results which are to be expected from the trip attraction and generation analysis. The coefficients of number of autos NC_i and NC_j are always negative and statistically significant. This is not the anticipated result and there is no satisfactory explanation. The coefficients of income terms I_i, I_j and $\bar{I}_{ij}$ are always statistically insignificant and never contributed to a large improvement in R. The coefficients of best time T_{bij} and relative time T_{rijk} are always negative and statistically significant. The demand should be inversely proportional to trip time, as was determined, and it is significant that the coefficients are essentially independent of model form. In other words, time is very important to a commuter. The coefficients of best cost C_{bij} and relative cost C_{rijk} are not

TABLE 5.2

RESULTS OF STEP-WISE REGRESSION ANALYSIS

DEMAND MODEL	1		2		3		4		5	
VARIABLE	COEF.	t	COEF.	t	COEF.	t	COEF	t	COEF.	t
$\ell n\, k$	19.3284		18.9607		22.5057		21.2165		21.2156	
$\ell n\, P_i$	0.2148	3.77			0.6582	9.39			0.2293	1.64
$\ell n\, P_j$	0.1728	3.05			0.5714	8.27			0.1530	1.09
$\ell n\, E_i$			0.4108	9.56			0.4295	10.10	0.2749	3.14
$\ell n\, E_j$			0.3652	8.61			0.3750	8.90	0.2648	3.01
$\ell n\, NC_i$					-0.3866	8.30	-0.1185	3.33	-0.2047	3.04
$\ell n\, NC_j$					-0.3519	7.66	-0.1253	3.54	-0.1813	2.69
$\ell n\, T_{ij}$										
$\ell n\, T_{bijk}$	-3.6935	35.75	-3.8135	40.50	-3.8473	40.30	-3.8178	41.30	-3.7939	38.30
$\ell n\, T_{rijk}$	-4.6370	26.50	-4.4158	28.78	-4.3727	28.60	-4.4514	29.30	-4.5808	27.52
$\ell n\, C_{bijk}$										
$\ell n\, C_{rijk}$										
$\ell n\, N_{mij}$	0.7254	6.29							0.2320	1.92
R	0.8264		0.8397		0.8403		0.8440		0.8454	
S.E.	1.061		1.022		1.0221		1.0111		1.0085	

TABLE 5.2 (CONTINUED)

RESULTS OF STEP-WISE REGRESSION ANALYSIS

DEMAND MODEL	6		7		8		9		10	
VARIABLE	COEF.	t	COEF.	t	COEF.	t	COEF.	t	COEF.	t
$\ln k$	18.3602		21.2245		20.3080		17.1231		19.4346	
$\ln P_i$	0.2179	3.81	0.2478	4.25	0.6208	8.40			0.2705	1.91
$\ln P_j$	0.1761	3.10	0.2090	3.61	0.5375	7.45			0.1951	1.37
$\ln E_i$							0.3898	8.70	0.2657	3.01
$\ln E_j$							0.3455	7.84	0.2533	2.85
$\ln NC_i$					-0.3715	7.61			-0.2314	3.38
$\ln NC_j$					-0.3419	7.19			-0.2073	3.03
$\ln \overline{T}_{ij}$			-0.3493	1.04						
$\ln T_{bijk}$	-3.8962	16.20	-3.5126	17.59	-4.4051	18.75	-3.8769	20.1	-4.3017	18.30
$\ln T_{rijk}$	-4.1908	8.90	-3.4117	8.52	-3.9608	8.80	-3.4892	9.17	-3.7587	8.35
$\ln C_{bijk}$	0.3297	1.25	0.0503	0.21	0.8450	3.27	0.4030	1.70	0.7471	2.90
$\ln C_{rijk}$	0.3041	1.03	0.7467	2.89	0.4347	1.55	0.7252	2.94	0.5612	2.00
$\ln N_{mij}$	0.7557	2.99			0.6882	2.85			0.3844	1.53
R	0.8267		0.8251		0.8441		0.8419		0.8470	
S.E.	1.0610		1.0652		1.0124		1.0173		1.0048	

often statistically important and are always positive. This result is contrary to the intuitive solution, where the cost coefficient would be negative. The apparent reason for this result is that the preponderance of travel is by auto, which is more expensive than either bus or rail. The statistical insignificance is also borne out by the lack of knowledge displayed by the auto drivers about the cost of the trip, as previously noted, and the preference rating results in which the cost rating has little or no influence on the overall trip rating. The coefficient of number of modes, N_{mij}, is always positive and statistically significant.

5.6 PERTURBATIONS OF THE DATA SET

Two perturbations of the demand matrix were made in an effort to improve the model results. The first perturbation was to truncate the demand matrix by eliminating all trip data pertaining to trip distances less than 11.5 miles, the object being to reduce the influence of short distance trips on the demand model, since the model was being developed primarily for the STOL mode. The second perturbation was to transform the symmetric truncated demand matrix into an asymmetric truncated demand matrix. The symmetric data was transformed to the same asymmetric ratio as the 30 x 30 BATSC asymmetric demand matrix, on a link by link basis, the purpose being to produce a matrix which could be used to develop a demand model which could predict direction of travel.

The results of these two perturbations are shown in Tables 5.3 and 5.4. Statistically, both perturbations degraded the results. The first perturbation reduced the value of R to a maximum of 0.8274 from the previous maximum of 0.847. The one noteworthy observation is that the coefficient of relative cost vanishes as being statistically insignificant. The remainder of the terms displayed essentially the same characteristics noted before in Table 5.2.

The results of the asymmetric matrix are statistically more disappointing, with the value of R being reduced to a maximum of 0.72. Columns 1 and 2 of Table 5.4 show the two forms of the demand models suggested in Section 5.4. Use of population serving employment at j offers a slightly improved R over the results of using the sum of population and employment at j. In all cases, the coefficients of best and relative cost are statistically insignificant.

Due to the lack of any positive results, neither of these two investigations were carried any further.

TABLE 5.3
STEP-WISE REGRESSION RESULTS
SYMMETRIC DEMAND MATRIX
DISTANCE $\geq$ 11.5 MILES

DEMAND MODEL	1		2		3		4	
VARIABLE	COEF.	t	COEF.	t	COEF.	t	COEF.	t
$\ln k$	18.3137		19.9134		18.9314		19.0734	
$\ln P_i$	0.2213	3.99	0.5157	6.72			0.1546	1.06
$\ln P_j$	0.1828	3.33	0.4378	5.86			0.0830	0.57
$\ln E_i$					0.3451	7.40	0.2642	2.94
$\ln E_j$					0.2943	6.50	0.2533	3.93
$\ln NC_i$			-0.2974	5.63	-0.0813	2.21	-0.1487	2.07
$\ln NC_j$			-0.2731	5.35	-0.0911	2.51	-0.1297	1.81
$\ln T_{bijk}$	-2.9571	13.35	-4.2372	16.80	-4.0303	16.50	-4.0954	16.85
$\ln T_{rijk}$	-4.2815	10.0	-5.3193	10.20	-5.2527	10.10	-5.2329	28.50
$\ln C_{bijk}$	-0.3892	1.43	0.7364	2.67	·0.5286	1.99	0.5960	2.63
$\ln C_{rijk}$	0.5005	1.83	-0.0526	0.16	-0.0095	0.03		
$\ln N_{mij}$			1.3534	5.22	1.0528	3.96	1.0917	4.93
R	0.8035		0.824		0.8271		0.8274	
S.E.	1.0157		0.9685		0.9606		0.9604	

TABLE 5.4
STEP-WISE REGRESSION RESULTS
ASYMMETRIC DEMAND MATRIX
DISTANCE $\geq$ 11.5 MILES

DEMAND MODEL	1		2		3		4	
VARIABLE	COEF.	t	COEF.	t	COEF.	t	COEF.	t
$\ell n\ k$	17.8464		19.2754		20.2495		20.0119	
$\ell n\ P_i$	0.2802	2.94	0.3310	3.52	0.2509	2.57		
$\ell n\ P_j$					0.5411	5.56		
$\ell n\ E_i$							0.1195	1.54
$\ell n\ E_j$							0.8738	11.40
$\ell n\ E_{psj}$			0.7719	10.68				
$\ell n\ P_j+E_j$	0.8219	8.78						
$\ell n\ T_{bijk}$	-4.2453	11.10	-4.4993	11.90	-3.9836	10.20	-4.6466	12.20
$\ell n\ T_{rijk}$	-4.4714	6.07	-4.3859	6.07	-4.6192	6.11	-4.4592	6.20
$\ell n\ C_{bijk}$	-0.0926	0.21	0.1424	0.32	-0.4193	0.91	0.1678	0.37
$\ell n\ C_{rijk}$	0.3645	0.77	0.4256	0.92	0.2517	0.52	0.3865	0.84
$\ell n\ N_{mij}$								
R	0.703		0.7165		0.6837		0.7202	
S.E.	1.7491		1.7155		1.7946		1.7061	

5.7 ADDITION OF PREFERENCE VARIABLES

The enroute time rating-distance relationship discussed in Section 4.10 was used to obtain a vector of observations on trip/vehicle characteristics in the following way. Distances were estimated for each commute corridor along the most direct highway route between superzone population centroids. The relationship of trip time rating with a corridor follows immediately from the rating-distance function for each mode operating on the corridor.

The thirteen other preference variables that were used in the overall trip rating regression models of Section 4.7 are not so obviously functions of actual time as is enroute trip time. Therefore, individual relationships with corridor distance for these thirteen could not be developed (at least not from this particular sample survey data). A crude relationship was structured by taking the ratio of the mean ratings of the group of thirteen, each, with the corridor-determined enroute trip time rating, for each modal vector of means. In other words, the mean ratings for the thirteen characteristics for mode k were each divided by the enroute trip time value for mode k that is associated with corridor (i, j).

The multiplicative mode split model was extended by including enroute trip time rating exponentially and the thirteen ratios exponentially. The model then, became

$$D_{ijk} = K \prod_{\ell=1}^{q} V(i,j,k)_{\ell}^{\alpha_{\ell}} \left[\exp\left(r_{ijk}\right) \exp\left(\sum_{p=1}^{13} \beta_p \hat{r}_{pijk}\right)\right]$$

where

r_{ijk} = Mean enroute trip time rating on the $(i,j)^{th}$ corridor for the k^{th} mode.

$\hat{r}_{pijk}$ = Ratio of mean rating for preference variable p with r_{ijk} for the k^{th} mode.

The first step-wise regression trial with this model for predicting demand showed a serious collinearity problem existed among the thirteen ratio type variables. In the correlation matrix several pairs of these variables had a coefficient of one while most of the others had values very close to one. In addition to this very grave circumstance, the relative time coefficient was positive. The step-wise approach was obviously not going to result in a usable model either with or without preference variables.

5.8 STRUCTURING THE MODEL BY RIDGE REGRESSION

It has been shown in References 5 and 6, that a ridge trace solution of coefficients can easily be determined that shows how sensitive a model is to collinearity. In particular, upon the sacrifice of a very small increase in the standard error of the demand, a set of coefficients can be found that minimizes the substitutional behavior of the coefficients. Such a set is selected from a formal series of solutions following an examination of a ridge trace which shows how little one must sacrifice in standard error in order to find stable coefficients that have theoretically correct signs and a reasonable magnitude. Although the ridge regression estimates are slightly biased, they have smaller standard error than do their ordinary least squares analog. The mathematical basis for ridge regression is presented in Appendix D.

In the first ridge regression trial, the same variables that had been used in the stepwise regression were used except for three preference variables, between which there existed correlation coefficients equal to one. These were Seat Comfort, Vehicle Appeal, and Route Alternatives. The ridge trace that resulted is shown in Figures 5.21 through 5.24. The traces for the eight socio-economic variables are shown in Figure 5.21. They are identified by number as follows:

1 = Population at origin = P_i

2 = Population at destination = P_j

3 = Employment at origin = E_i

4 = Employment at destination = E_j

5 = Number of cars at origin = NC_i

6 = Number of cars at destination = NC_j

7 = Median income at origin = I_i

8 = Median income at destination = I_j

The two income traces are very stable and near zero which is evidence of their lack of predictive power. Accordingly, these variables were dropped from further consideration. The other six variables evidently are quite stable and have predictive power, although the two population variables are the weakest among the six.

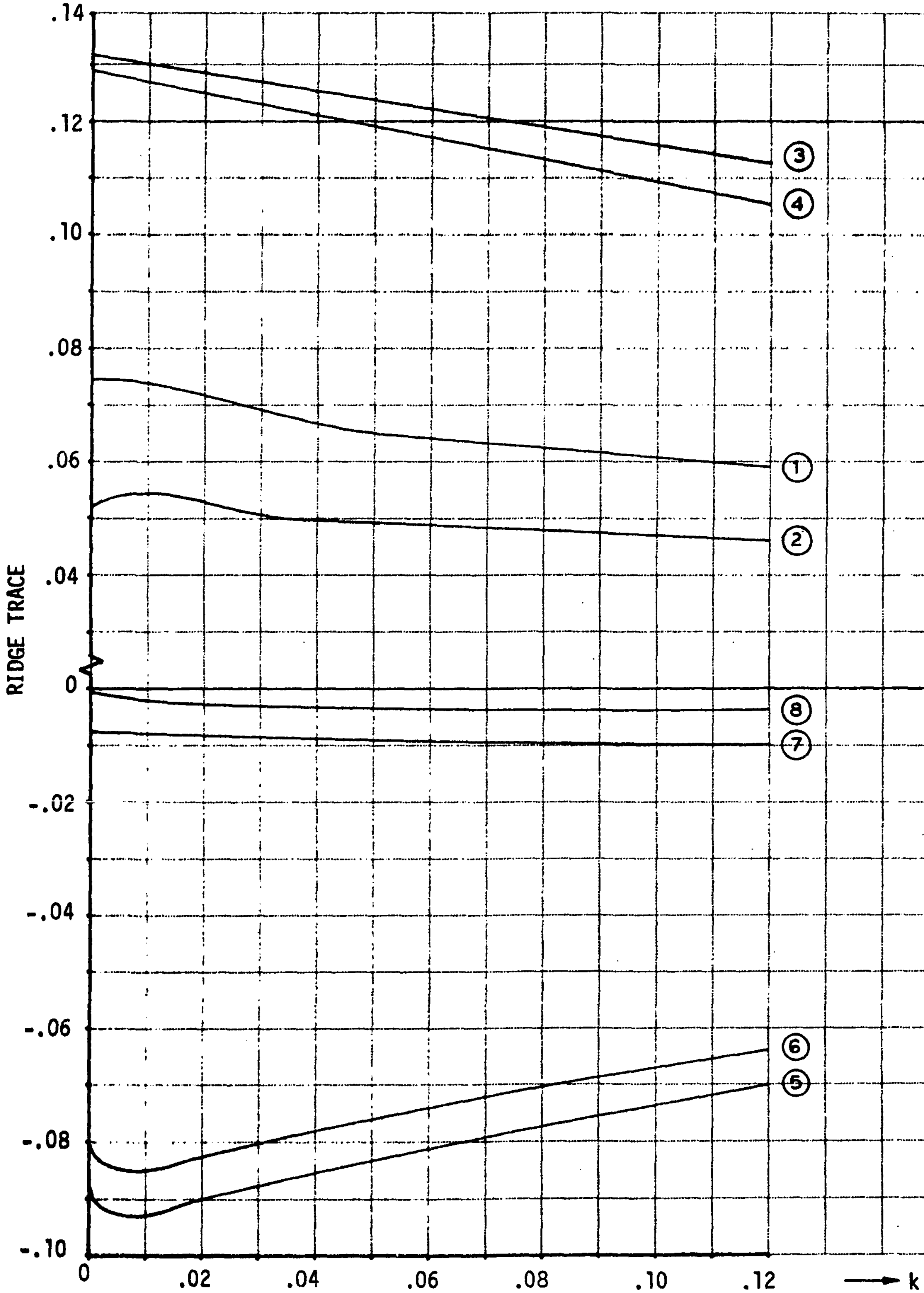


Figure 5.21

Ridge Trace for Eight Socio-Economic Variables

The ridge traces for five modal variables are shown in Figure 5.22 along with the track for the standard error, S.E. The variables are identified as follows:

10 =	Best time	=	T_{bij}
11 =	Relative time for mode k	=	T_{rijk}
12 =	Number of modes serving corridor	=	N_m
13 =	Best cost	=	C_{bij}
14 =	Relative cost for mode k	=	C_{rijk}

In these traces there is evidence of considerable instability in number of modes and in relative cost coefficients. Number of modes starts out positive for the ordinary least squares solution at $k = 0$ and stabilizes with a negative value close to zero. Intuitively one expects number of modes in this kind of model to have a negative coefficient. The relative cost coefficient, however, starts out with the correctly negative sign but stabilizes with a positive value. The best cost trace is properly negative and very stable. The traces for best and relative time are properly negative and tending to stability after $k = 0.03$. The penalty in standard error increment from ordinary least squares solution at $k = 0$ to ridge solution at $k = 0.03$ is only 0.032.

The ridge traces for the first five preference variables are shown in Figure 5.23. They are identified by number as follows:

15 = Enroute trip time $= r(t)_{ijk}$
16 = Trip cost ratio
17 = Spaciousness ratio
18 = Vehicle Storage ratio
19 = Vehicle climate ratio

The extremely high collinearity between the ratio-type preference variables is all too clear in these traces. All traces immediately zoom to the zero line and stabilize around it except for Enroute Trip Time. The latter's trace starts off in the ordinary least squares solution (the one that would be obtained by the stepwise algorithm) with an incorrectly negative value and stabilizes at a fairly powerful positive value. This is the only variable out of these five that should be retained in the model.

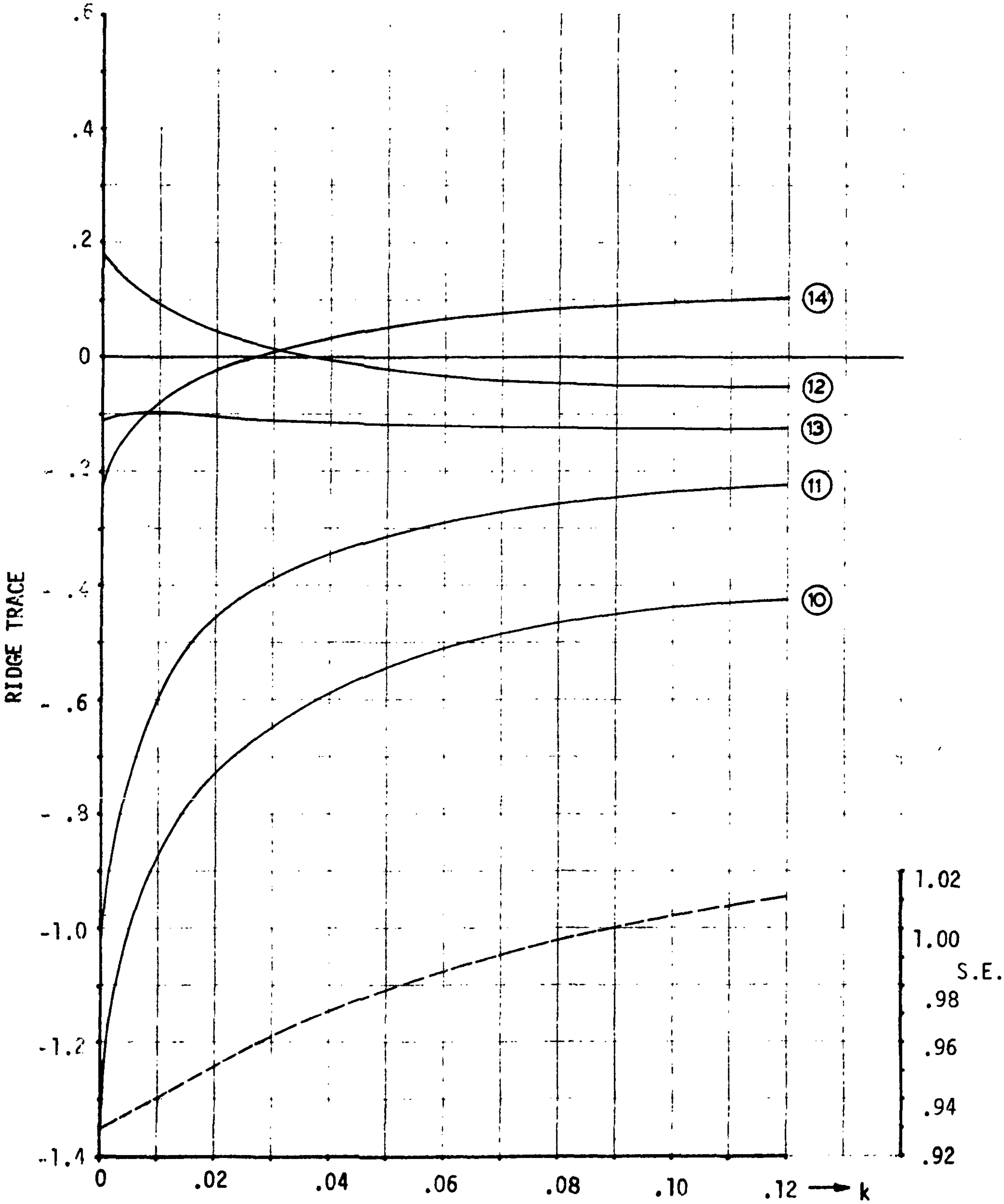


Figure 5.22

Ridge Trace for Five Modal Variables

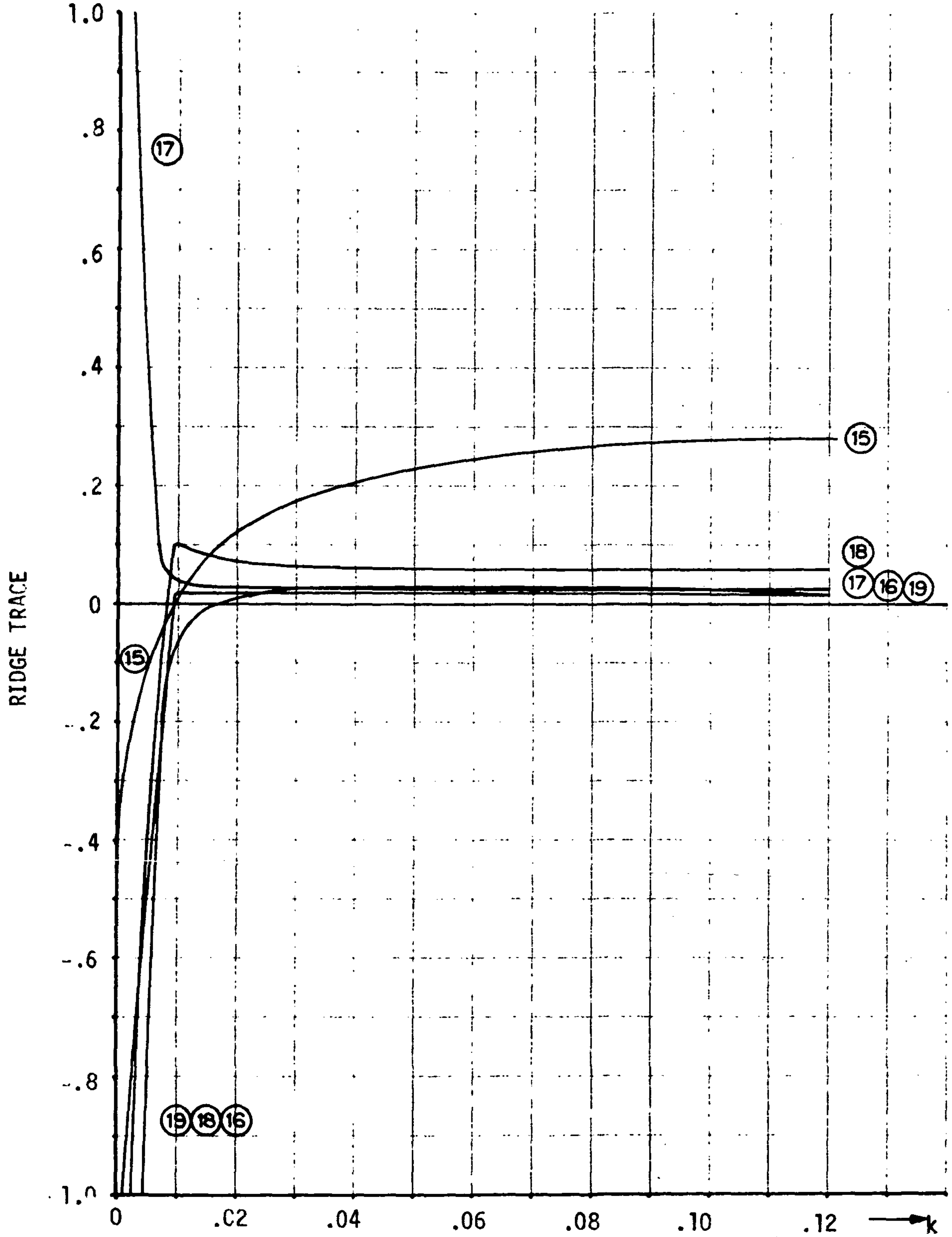


Figure 5.23
Ridge Trace for the First Five Preference Variables

The ridge traces for the last six preference variables are shown in Figure 5.24. They are identified by number as follows:

20 = Smoothness ratio

21 = Physical side effects ratio

22 = Noise level ratio

23 = Safety Ratio

24 = Privacy ratio $= \hat{r}(p)_{ijk}$

25 = Productive use of time ratio $= \hat{r}(u)_{ijk}$

Again the high collinearity gives spurious values for the ordinary least squares solution at $k = 0$ and quick stability about zero except for Privacy and Productive Use of Time. Both of these have a respectable although weak trace value. These two preference variables should be retained and the other four deleted.

Considering the evidence of the ridge traces, experience teaches that the best solution is the one for $k = 0.03$. However, although these criteria say that the best cost variable should be deleted, it was deliberately retained in order to be able to measure the sensitivity of the model to it upon the final fit. That this was a wise decision is fully supported by the remarks in Section 6 when application of a cost factor is discussed.

Finally, a ridge regression was made upon the following variables:

P_i, P_j, E_i, E_j, NC_i, NC_j, T_{bij}, T_{rijk}, C_{bij}, C_{rijk},

r_{ijk}, $\hat{r}(p)_{ijk}$, $\hat{r}(u)_{ijk}$

The complete computer listing for this trial is presented as Figure 5.25. Note that the last page contains a summary of the ridge trace points.

The best solution was selected at $k = 0.03$. The results for $k = 0.03$ are boxed in with heavy lines in Figure 5.25. The final model, then, to be used for predicting demand for the various modes in the San Francisco intraurban area is given by the antilog of the following equation:

$$\begin{aligned} \ell n D_{ijk} = {} & 22.400 + 0.196\ \ell n P_i + 0.138\ \ell n P_j \\ & + 0.332\ \ell n E_i + 0.322\ \ell n\ E_j - 0.186\ \ell n\ NC_i \\ & - 0.161\ \ell n\ NC_j - 3.803\ \ell n\ T_{bij} - 3.911\ \ell n\ T_{rijk} \\ & - 0.361\ \ell n C_{bij} - 0.119\ \ell n C_{rijk} + 0.058\ r(t)_{ijk} \\ & + 0.376\ \hat{r}(p)_{ijk} - 0.131\ \hat{r}(u)_{ijk} \end{aligned}$$

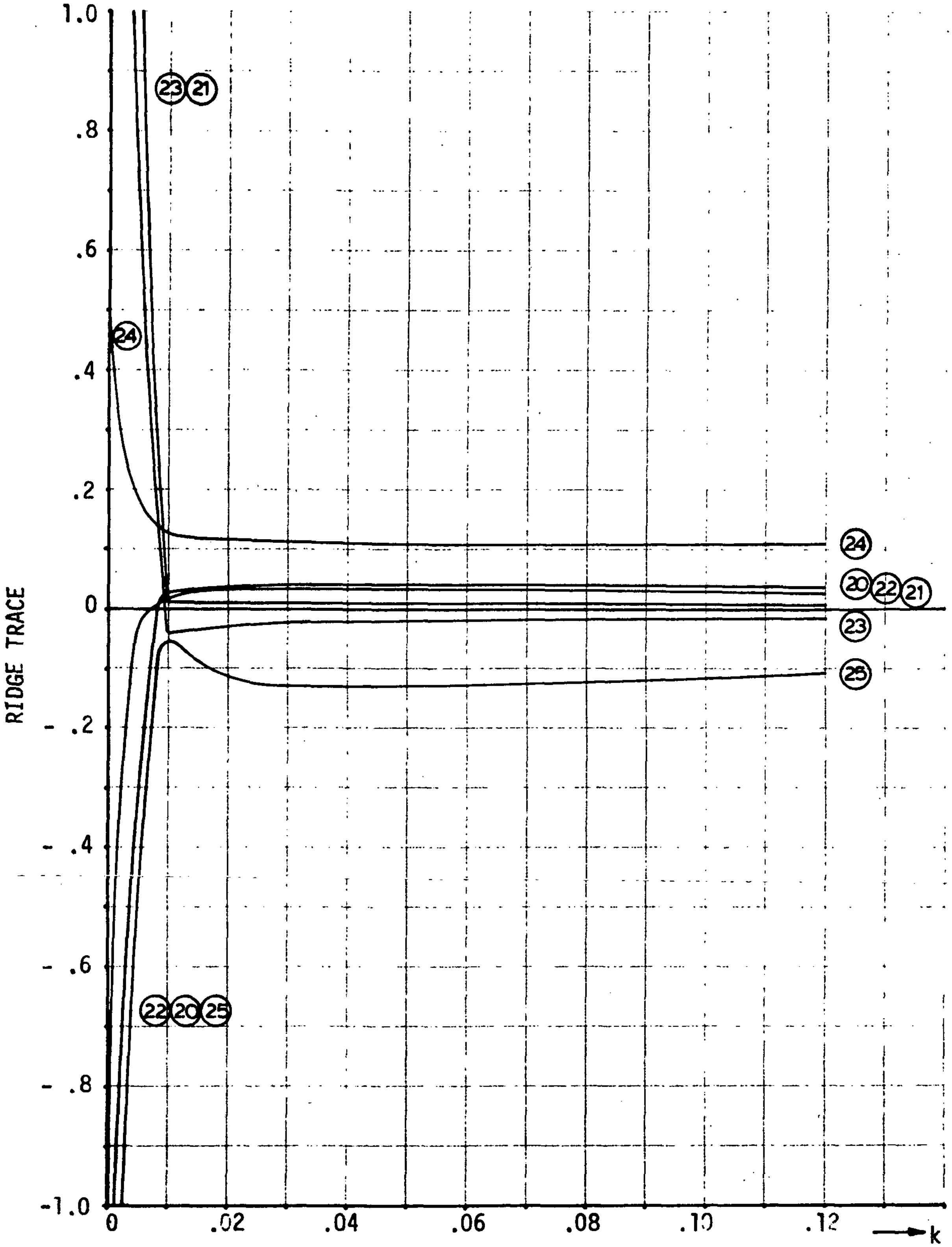


Figure 5.24

Ridge Trace for the Last Six Preference Variables

R I D G E   R E G R E S S I O N
SYSTEM ANALYSIS, BOEING COMPUTER SERVICES.

PROBLEM CODE	NASA II
NUMBER OF CASES	912
NUMBER OF ORIGINAL VARIABLES	25
NUMBER OF VARIABLES ADDED	-0
TOTAL NUMBER OF VARIABLES	25
NUMBER OF SUB-PROBLEMS	2
TIME SLICE, FIRST CASE	1
TIME SLICE, LAST CASE	912

FORMAT (5X,4F5.0,10X,4F6.0,F7.0, F5.0,F5.2,F2.0/4F5.0,5X,7F5.0,1X,2F5.0)

VARIABLE	MEAN	STANDARD DEVIATION
1 = ΔP_i	4.93889	.64553
2 = ΔP_j	4.95710	.64704
3 = ΔE_i	3.93569	.81841
4 = ΔE_j	3.95374	.52249
5 = ΔNC_i	3.73390	.94753
6 = ΔNC_j	3.74453	.95756
7	9.21753	.15777
8	9.23555	.15709
9 = ΔD_{ijk}	6.33510	1.57834
10 = ΔT_{oij}	3.43673	.40376
11 = ΔT_{rijk}	.15344	.24710
12	.45543	.40056
13 = ΔC_{bijk}	4.73541	.52971
14 = ΔC_{tijk}	.25567	.38150
15 = $r(E)_{ijk}$	3.33506	1.22314
16	1.54144	1.04732
17	1.70356	1.13878
18	1.73534	1.21145
19	1.65502	1.17439
20	1.75556	1.11913
21	2.23247	1.44137
22	1.51741	1.15595
23	1.33514	1.33224
24 = $r(D)_{ijk}$	1.63390	1.28400
25 = $r(U)_{ijk}$	1.13784	.84223

Figure 5.25

Ridge Regression Computer Listing for Final Model

CORRELATION MATRIX

VARIABLE NUMBER	1 = $\ell n P_i$	2 = $\ell n P_j$	3 = $\ell n E_i$	4 = $\ell n E_j$	5 = $\ell n NC_i$	6 = $\ell n NC_j$	7	8	9 = $\ell n D_{ijk}$	10 = $\ell n T_{Mit}$
1	1.000	.075	.710	.030	.329	.069	.331	.066	.210	-.241
2		1.000	.072	.707	.044	.626	.051	.334	.199	-.227
3			1.000	-.008	.044	.113	.101	.092	.233	-.216
4				1.000	.061	.032	.055	.095	.202	-.190
5					1.000	-.025	.418	-.007	.035	-.104
6						1.000	.036	.422	.038	-.139
7							1.000	-.010	.045	-.031
8								1.000	.055	-.386
9									1.000	-.648
10										1.000

CORRELATION MATRIX (CONT.D)

VARIABLE NUMBER	11 = $\ell n T_{rijk}$	12	13 = $\ell n C_{bij}$	14 = $\ell n C_{rijk}$	15 = $r(t)_{ijk}$	16	17	18	19	20
1	.136	.268	-.284	.135	.185	-.151	-.196	-.220	-.187	-.136
2	.138	.263	-.269	.124	.177	-.205	-.242	-.254	-.236	-.244
3	.205	.394	-.336	.177	.132	-.108	-.174	-.223	-.159	-.174
4	.153	.365	-.305	.160	.115	-.164	-.212	-.240	-.202	-.214
5	.030	-.023	-.026	-.019	.130	-.122	-.109	-.086	-.113	-.111
6	.029	.011	-.042	-.013	.131	-.130	-.128	-.113	-.130	-.130
7	.050	.073	-.071	.014	.103	-.108	-.103	-.091	-.104	-.106
8	.038	.050	-.056	.004	.107	-.114	-.107	-.093	-.109	-.115
9	-.173	.237	-.514	.605	.750	-.399	-.370	-.293	-.383	-.370
10	-.415	-.439	.857	-.375	-.781	.549	.670	.700	.651	.652
11	1.000	.559	-.533	-.352	-.168	-.036	-.263	-.454	-.211	-.254
12		1.000	-.814	.468	.185	-.170	-.333	-.457	-.297	-.329
13			1.000	-.521	-.555	.418	.593	.683	.560	.562
14				1.000	.583	-.253	-.189	-.106	-.207	-.143
15					1.000	-.679	-.637	-.526	-.654	-.644
16						1.000	.930	.765	.956	.943
17							1.000	.947	.997	.939
18								1.000	.918	.936
19									1.000	.998
20										1.000

Figure 5.25 (Continued)

CORRELATION MATRIX (CONT.D)

VARIABLE NUMBER	21	22	23	$24 = \hat{r}(p)_{tjk}$	$25 = \hat{r}(u)_{tjk}$
1	-.159	-.189	-.142	-.227	-.391
2	-.221	-.238	-.197	-.260	-.147
3	-.132	-.163	-.095	-.235	-.026
4	-.182	-.216	-.152	-.251	-.090
5	-.118	-.114	-.120	-.086	-.113
6	-.131	-.131	-.128	-.113	-.116
7	-.115	-.107	-.102	-.094	-.083
8	-.112	-.111	-.109	-.095	-.091
9	-.398	-.379	-.411	-.279	-.425
10	.507	.649	.551	.694	.465
11	-.118	-.217	-.010	-.479	.157
12	-.239	-.332	-.146	-.478	-.007
13	.493	.559	.413	.686	.296
14	-.235	-.205	-.261	-.096	-.291
15	-.575	-.555	-.581	-.520	-.657
16	.932	.960	.937	.761	.953
17	.974	.995	.932	.941	.843
18	.551	.915	.766	.997	.636
19	.989	.993	.958	.911	.880
20	.951	.993	.941	.932	.851
21	1.000	.990	.989	.844	.931
22		1.000	.959	.910	.877
23			1.000	.756	.971
24				1.000	.512
25					1.000

Figure 5.25 (Continued)

```
SUB-PROBLEM    1
 DEPENDENT VARIABLE          9
 NUMBER OF K                11
 VARIABLE SELECTION
 -0-0-0-0-0-0 1 1 2-0-0 1-0-0-0 1 1 1 1 1 1 1-0-0

FOR K =0.000     D(K) =     0.000     DELT(K) = 0.000

VARIABLES    CONST.     1      2      3      4      5      5     10      11      13     14
                       15     24     25

RIDGE TRACE =         .059   .037   .159   .156  -.087  -.074  -.980   -.611   -.093  -.025
                     -.105   .232  -.354
COEFF. =    25.335    .171   .109   .364   .356  -.172  -.145  -4.559  -4.646  -.278  -.130
                     -.164   .340  -.120

        SS =    833.4128      SE =     .9760        MULTIPLE R =     .8566

FOR K = .010     D(K) =      .390     DELT(K) =  .269

VARIABLES    CONST.     1      2      3      4      5      5     10      11      13     14
                       15     24     25

RIDGE TRACE =         .064   .045   .144   .140  -.090  -.079  -.813   -.509   -.113  -.014
                      .031   .245  -.357
COEFF. =    24.263    .178   .117   .356   .347  -.173  -.150  -4.351  -4.483  -.323  -.152
                     -.105   .353  -.124

        SS =    836.7367      SE =     .9762        MULTIPLE R =     .8545

FOR K = .020     D(K) =      .567     DELT(K) =  .339

VARIABLES    CONST.     1      2      3      4      5      5     10      11      13     14
                       15     24     25

RIDGE TRACE =         .066   .049   .135   .131  -.09   -.080  -.716   -.444   -.113   .003
                      .107   .245  -.357
COEFF. =    22.943    .163   .129   .343   .334  -.18   -.155  -4.060  -4.196  -.353  -.145
                     -.019   .367  -.129

        SS =    853.6151      SE =     .9773        MULTIPLE R =     .8514
```

Figure 5.25 (Continued)

FOR K = .030	D(K) =	.662	DELT(K) =	.475							
VARIABLES	CONST.	$1 = \ell nP_i$ $15 = r(t)_{ijk}$	$2 = \ell nP_j$ $24 = \hat{r}(p)_{ijk}$	$3 = \ell nE_i$ $25 = \hat{r}(u)_{ijk}$	$4 = \ell nE_j$	$5 = \ell nNC_i$	$5 = \ell nNC_j$	$10 = \ell nT_{bijk}$	$11 = \ell nT_{rijk}$	$13 = \ell nC_{bijk}$	$14 = \ell nC_{rijk}$
RIDGE TRACE =		.067 .156	.050 .240	.129 -.056	.124	-.090	-.083	-.650	-.398	-.110	.019
COEFF. =	22.400	.196 .058	.138 .376	.332 -.131	.322	-.186	-.161	-3.803	-3.911	-.361	-.119
SS =	861.7244		SE =	.9790		MULTIPLE R =		.8484			

FOR K = .040	D(K) =	.716	DELT(K) =	.524							
VARIABLES	CONST.	1 15	2 24	3 25	4	5	5	10	11	13	14
RIDGE TRACE =		.066 .189	.051 .233	.125 -.055	.119	-.088	-.073	-.601	-.364	-.106	.032
COEFF. =	20.575	.201 .123	.145 .381	.323 -.131	.313	-.189	-.165	-3.588	-3.659	-.358	-.083
SS =	863.5358		SE =	.9812		MULTIPLE R =		.8458			

FOR K = .050	D(K) =	.748	DELT(K) =	.558							
VARIABLES	CONST.	1 15	2 24	3 25	4	5	5	10	11	13	14
RIDGE TRACE =		.065 .213	.050 .226	.121 -.054	.115	-.087	-.078	-.563	-.338	-.103	.044
COEFF. =	19.622	.204 .176	.151 .383	.316 -.130	.305	-.191	-.167	-3.407	-3.442	-.358	-.046
SS =	859.5406		SE =	.9835		MULTIPLE R =		.8434			

FOR K = .060	D(K) =	.768	DELT(K) =	.584							
VARIABLES	CONST.	1 15	2 24	3 25	4	5	5	10	11	13	14
RIDGE TRACE =		.064 .230	.050 .219	.118 -.054	.111	-.085	-.075	-.533	-.318	-.108	.053
COEFF. =	18.863	.206	.154	.310	.298	-.192	-.165	-3.254	-3.257	-.341	-.008

Figure 5.25 (Continued)

		.221	.383	-.129						

SS = 873.5373 SE = .9958 MULTIPLE R = .6413

FOR K = .070 D(K) = .778 DELT(K) = .603

VARIABLES	CONST.	1 15	2 24	3 25	4	5	5	10	11	13	14
RIDGE TRACE =		.063 .243	.049 .212	.115 -.053	.105	-.083	-.075	-.507	-.301	-.098	.062
COEFF. =	16.095	.206 .256	.155 .382	.305 -.127	.292	-.192	-.163	-3.122	-3.097	-.331	.027

SS = 877.5529 SE = .9880 MULTIPLE R = .8393

FOR K = .080 D(K) = .784 DELT(K) = .619

VARIABLES	CONST.	1 15	2 24	3 25	4	5	5	10	11	13	14
RIDGE TRACE =		.062 .253	.049 .205	.113 -.053	.105	-.081	-.073	-.486	-.287	-.096	.070
COEFF. =	17.473	.206 .289	.157 .379	.300 -.125	.287	-.191	-.163	-3.008	-2.960	-.323	.061

SS = 881.3168 SE = .9902 MULTIPLE R = .8374

FOR K = .090 D(K) = .785 DELT(K) = .631

VARIABLES	CONST.	1 15	2 24	3 25	4	5	5	10	11	13	14
RIDGE TRACE =		.061 .262	.048 .199	.111 -.052	.103	-.079	-.072	-.467	-.275	-.095	.076
COEFF. =	15.933	.205 .315	.158 .376	.296 -.123	.283	-.190	-.163	-2.907	-2.840	-.315	.093

SS = 885.0530 SE = .9922 MULTIPLE R = .8356

FOR K = .100 D(K) = .783 DELT(K) = .641

Figure 5.25 (Continued)

VARIABLES	CONST.	1 15	2 24	3 25	4	5	5	10	11	13	14
RIDGE TRACE =		.363 .266	.047 .192	.139 -.352	.101	-.077	-.070	-.450	-.265	-.094	.082
COEFF. =	15.461	.234 .338	.156 .372	.293 -.121	.279	-.189	-.169	-2.817	-2.735	-.307	.123

SS = 833.5525 SE = .9942 MULTIPLE R = .8339

FOR K = .126 D(K) = .774 DELT(K) = .657

VARIABLES	CONST.	1 15	2 24	3 25	4	5	5	10	11	13	14
RIDGE TRACE =		.058 .274	.045 .131	.135 -.052	.097	-.073	-.067	-.423	-.248	-.092	.093
COEFF. =	15.655	.201 .374	.157 .363	.287 -.117	.272	-.185	-.165	-2.664	-2.551	-.296	.179

SS = 835.1530 SE = .9979 MULTIPLE R = .8306

Figure 5.25 (Continued)

SUMMARY TABLE

K	D(K)	DET(K)	RIDGE TRACE 1 / 15	2 / 24	3 / 25	4	5	6	10	11	13	14
.000	0.000	0.000	.059	.037	.159	.156	-.087	-.074	-.980	-.611	-.093	-.026
			-.105	.232	-.054							
.010	.333	.269	.064	.045	.144	.140	-.090	-.079	-.813	-.509	-.113	-.014
			.031	.245	-.057							
.020	.557	.399	.066	.049	.135	.131	-.091	-.080	-.716	-.444	-.113	.003
			.137	.245	-.057							
.030	.652	.475	.067	.050	.129	.124	-.090	-.080	-.650	-.398	-.110	.019
			.156	.240	-.056							
.040	.715	.524	.065	.051	.125	.119	-.088	-.079	-.601	-.364	-.106	.032
			.189	.233	-.055							
.050	.7-3	.558	.065	.050	.121	.115	-.087	-.078	-.563	-.333	-.103	.044
			.213	.226	-.054							
.060	.763	.584	.064	.050	.118	.111	-.085	-.076	-.533	-.318	-.100	.053
			.230	.219	-.054							
.070	.778	.603	.063	.049	.115	.108	-.083	-.075	-.507	-.301	-.098	.062
			.243	.212	-.053							
.080	.784	.519	.062	.049	.113	.106	-.081	-.073	-.486	-.287	-.096	.070
			.253	.205	-.053							
.090	.785	.531	.061	.048	.111	.103	-.079	-.072	-.467	-.275	-.095	.076
			.260	.199	-.052							
.100	.783	.541	.060	.047	.109	.101	-.077	-.070	-.450	-.265	-.094	.082
			.265	.192	-.052							
.120	.774	.557	.058	.046	.105	.097	-.073	-.067	-.423	-.248	-.092	.093
			.274	.181	-.052							

Figure 5.25 (Concluded)

5.9 SELECTION OF TERMS FOR THE GENERALIZED DEMAND MODEL

The above analysis has brought several of the variables into perspective and has enabled the selection of those terms considered to be necessary for a generalized demand model. The obvious terms of population and employment have to be included, but so also must the number of automobiles. As noted previously, the coefficient for the number of automobiles is negative, for which there is no adequate explanation. However, elimination of the term, number of automobiles, has an adverse effect on the population terms by forcing the coefficients to be negative. To include the population terms with negative coefficients would be an impossibility. However, because the statistical solution is improved, the number of automobiles were included in the demand model.

The median income and weighted incomes never contributed to the improvement of a demand model and were not included in the generalized model.

The best and relative times and costs were included in the final model due to the statistical importance of time and the intuitive importance of cost. The Ridge Trace regression technique was relied upon to yield the values of the coefficients, since the step-wise regression solution had yielded positive coefficients. In the selection of the solution for the best and relative coefficients, a great deal of care should be exercised. Consider, for example, the best and relative time components of the generalized demand model.

$$D_{ijk} = f(T_{bij}^{\alpha_1} \; T_{rijk}^{\alpha_2})^{-1} = f[T_{bij}^{\alpha_1-\alpha_2} \; T_{ijk}^{\alpha_2}]^{-1}$$

since

$$T_{rijk} = \frac{T_{ijk}}{T_{bij}}$$

Therefore, when $\alpha_1 < \alpha_2$ (Case 1)

then

$$D_{ijk} = f\left[\frac{T_{bij}^{\alpha_2-\alpha_1}}{T_{ijk}^{\alpha_2}}\right]$$

that is, the introduction of a new mode with a lower trip time can reduce the traffic on the old mode.

When $\alpha_1 = \alpha_2$ (Case 2)

then

$$D_{ijk} = f[T_{ijk}^{-\alpha_2}]$$

and the new mode has no impact on the old mode.

When $\alpha_1 > \alpha_2$ (Case 3)

then

$$D_{ijk} = f\left[\frac{1}{T_{bij}^{\alpha_1-\alpha_2}\;T_{ijk}^{\alpha_2}}\right]$$

and the new mode with the lower trip time has increased the traffic on the old mode.

Now on intuitive grounds, it would be anticipated that the introduction of a new, faster mode would penalize the previously existing modes. For this reason, the coefficients of time and cost should be selected with absolute value of the coefficient for the best term being smaller than the absolute value of the coefficient of the term for the k^{th} mode.

5.10 SENSITIVITY OF THE DEMAND MODEL TO THE PREFERENCE VARIABLES

The range in sensitivity of the demand model to the preference type variables can be seen in Figure 5.26. The figure shows the envelope for the increment of the logarithm of demand contributed by the three preference type variables in the model, namely, enroute trip time rating, privacy rating, and productive-use-of-time rating. For the sake of clarity in interpretation of the envelope it will be helpful to recall the following details.

1. The enroute trip time rating per mode was assigned to each corridor according to the functional relationships between enroute trip time rating and distance determined from the surveys as shown graphically in Figures 4.26 and 4.27.

2. The enroute trip time rating, $r(t)_{ijk}$, enters the model directly in "stanine" units. However, the privacy and productive-use-of-time variables are formed as the ratio of the respective mean ratings per mode with the enroute trip time rating per mode; i.e.,

$$\hat{r}(p)_{ijk} = \overline{r(p)}_k \;/\; r(t)_{ijk}$$

and

$$\hat{r}(u)_{ijk} = \overline{r(u)}_k \;/\; r(t)_{ijk}$$

The increment in logarithm of demand due to preference type variables is represented, therefore, as follows:

$$\Delta \ell n d_{ijk} = \alpha_1 r(t)_{ijk} + \alpha_2 \hat{r}(p)_{ijk} + \alpha_3 \hat{r}(u)_{ijk}$$

where the coefficients have been determined from the Ridge Regression analysis as

$$\alpha_1 = 0.058$$

$$\alpha_2 = 0.376$$

$$\alpha_3 = -0.131$$

Inasmuch as the two ratio type preference variables are functions of enroute trip time, the demand increment envelope is constructed by fixing $\overline{r(p)}_k$ and $\overline{r(u)}_k$ at each combination of their extremes and then allowing $r(t)_{ijk}$ to vary over its entire range from a minimum of one to a maximum of nine, in the equation above.

It is important to note that the envelope contains the totality of incremental values that can arise from the model when one extrapolates beyond the preference variable bounds that actually occurred in the sample upon which the regression fit is based. The increments from preference variables to the demands actually predicted by the model for use in the network analysis described in Section 6 of this report reside strictly on the three curves indicated by dashed lines and labeled Auto, Train, and Bus, respectively.

With respect to the envelope, although by no means is extrapolation recommended, it is interesting to note the wide variation in incremental logarithm demand that may arise from the model. It is sufficient to

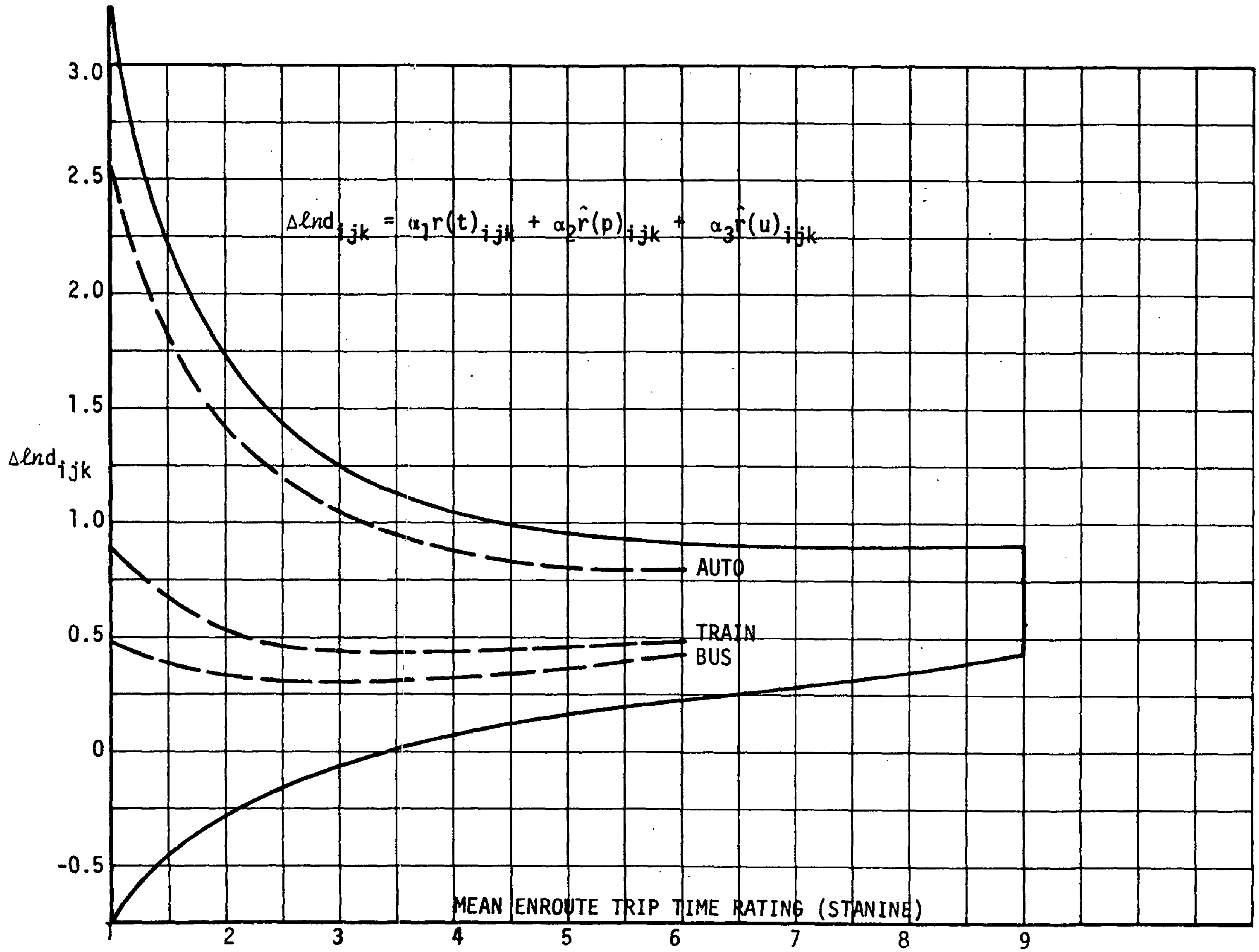


FIGURE 5.26 - ENVELOPE FOR INCREMENT OF MEAN LOG DEMAND DUE TO VARIATION IN PREFERENCE VARIABLES

note that at a middle rating of five for enroute trip time rating, the lower and upper limits of the envelope have the values 0.129 and 0.941, respectively. These logarithms correspond to multiplicative factors on the demand of 1.12 and 2.56, respectively. This is indicative of an important and significant contribution to predicted demand by preference variables that are designed to capture attitudes of commuters toward their available and potential modes of transportation.

The actual multiplicative factors due to preference variables that were contained in the demands that were predicted by the model and used in the network analysis ranged between 2.17 and 12.7 for auto, 1.55 and 2.42 for train, and 1.37 and 1.62 for bus.

6.0 APPLICATION OF MODEL TO SAN FRANCISCO BAY AREA

The generalized intraurban demand model described in Section 5 was applied to the San Francisco Bay Area. The model was applied to both the 1965 and 1980 time periods, with and without an air mode of transportation.

The thirty superzones discussed in Section 5 were used for all applications. Demand was assumed concentrated at the population centroids of these zones. The times, costs and attitude ratings for the various modes which were presented in Section 5 were used for the applications. Demographic data for the two time periods was based upon the MTC (Metropolitan Transit Commission) reports. The 1965 data came from their surveys; the 1980 data came from the MTC land use forecasts.

The zone pairs for which traffic was predicted are those described in Section 5. These are those zone pairs on which some traffic (more than one person per day) was recorded in the MTC home interview survey. About two-thirds of the 870 possible zone pairs are included.

The demand model described in Section 5 is quite insensitive to differences in relative costs of the various transportation modes. In the transportation system on which the model was calibrated, relative cost of competing modes had little influence upon people's choice of mode. Cost was a secondary factor, largely because the cost differences between public modes were slight, and the perceived auto costs varied widely. Since STOL costs are significantly higher than those of other public modes, when the model is applied to V/STOL one is applying the model well outside of the range for which it was calibrated. We felt that people would be more sensitive to a $4.00 to $2.00 cost difference than to a $ .50 to $ .25 cost difference.

In order to obtain a more appropriate cost sensitivity for V/STOL, the coefficient of relative cost was multiplied by 5 when the model was used to predict V/STOL traffic. Other multipliers were tried with 5 chosen on a judgemental basis. This is somewhat arbitrary, of course, and shows the need for more work in the area of cost sensitivity for public modes of transportation.

The rest of Section 6 describes the results of applying the demand model to the Bay Area. Section 6.1 shows these results. Section 6.2 shows the effect of the demand upon the air system. In particular, Section 6.2 compares the air system needed to handle the predicted demand with the system defined in the previous intraurban study, Reference 1.

6.1 RESULTS OF DEMAND MODEL

Figure 6.1 shows the result of applying the demand model to the Bay Area in 1965 with an air mode added. The figure shows the number of person trips at various ranges for Auto, Bus, Train, STOL and the total of the four. Note that beyond 36 miles the demand for STOL is greater than that for auto. When the air mode is omitted, the model predicts only a small increase in travel for the other modes. Thus, most of the demand for STOL represents new travel rather than diverted traffic. The total traffic without STOL can be calculated from the figure by subtracting the STOL traffic from the total shown. For 1965, the model predicts a total of 2,944,717 person trips without STOL and 3,362,303 with the air system of which 423,347 trips represent demand for STOL.

It should be remembered that these are trips that begin in one superzone and end in another. The total is then considerably less than the 11.8 million total trips made in the nine counties each day, which includes trips within zones as well.

Figure 6.2 shows the effect of STOL fare on total travel and demand for STOL in 1965. The effect of fare is quite uniform with range, becoming somewhat stronger at the longer ranges. The total effect upon demand of a 30% fare reduction is quite small: STOL demand goes from 423,347 to 522,473, an increase of 19%. Total demand goes up by 3%.

Figure 6.3 shows predicted and actual demands for 1965 (without STOL, of course). The model somewhat underpredicts auto trips. The sum of bus and train trips are predicted quite accurately, but the individual predictions are less exact. There seems to be no significant range bias in the model.

Figure 6.4 displays the same information for 1980 as Figure 6.1 displays for 1965. The similarity of the figures shows that no large change in travel patterns is forecast by the model by 1980. The distribution of trip by trip length and by mode changes very little. Of course, the land use model which calculated population and employment in each superzone did not allow for the existence of a STOL system. By allowing STOL to effect land use, one might see greater changes in travel between 1965 and 1980.

Figure 6.5 shows the effect of STOL fare upon total travel and demand for STOL. The similarity of Figures 6.2 and 6.5 show that

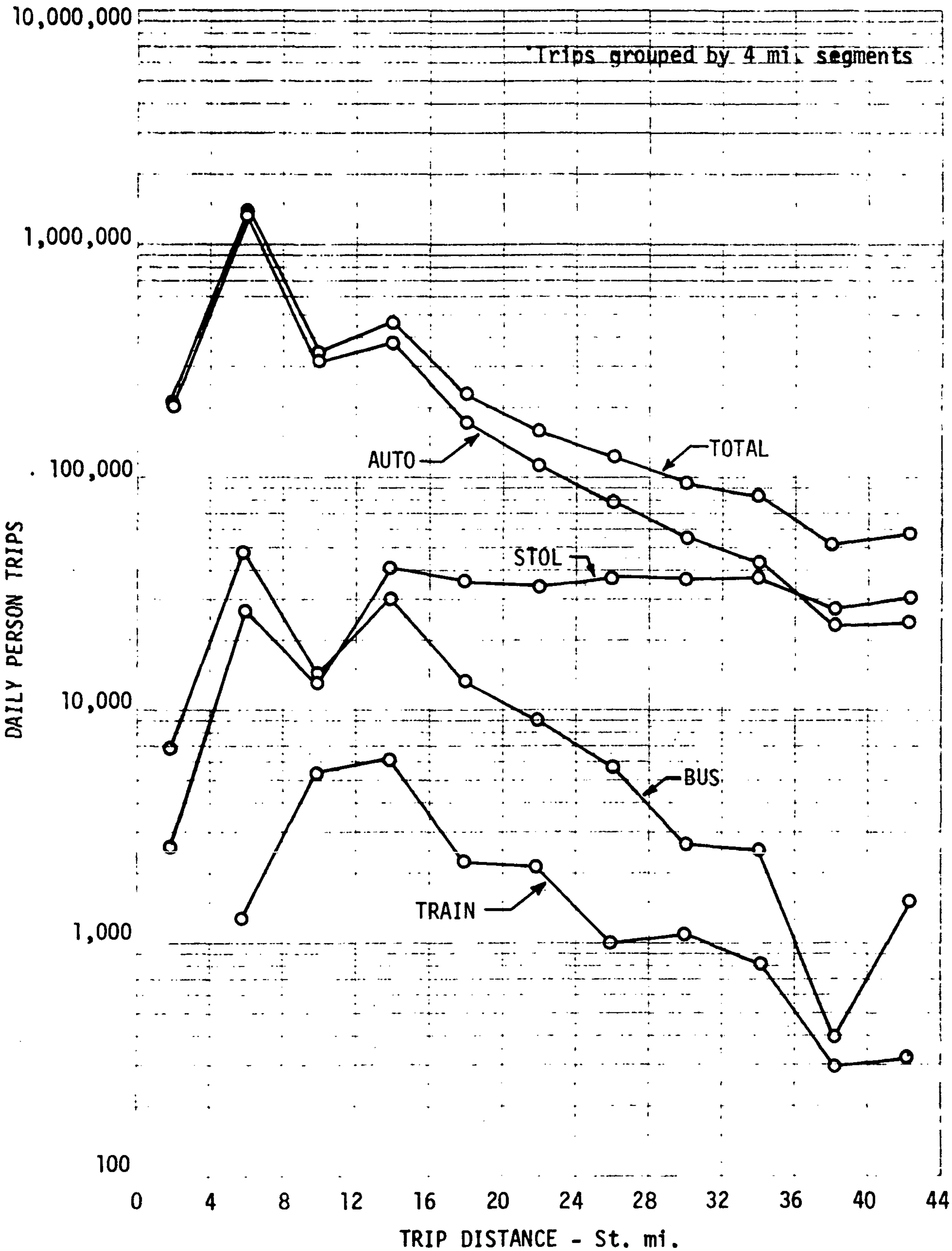


FIGURE 6.1: DEMAND MODEL RESULTS BY MODE - 1965

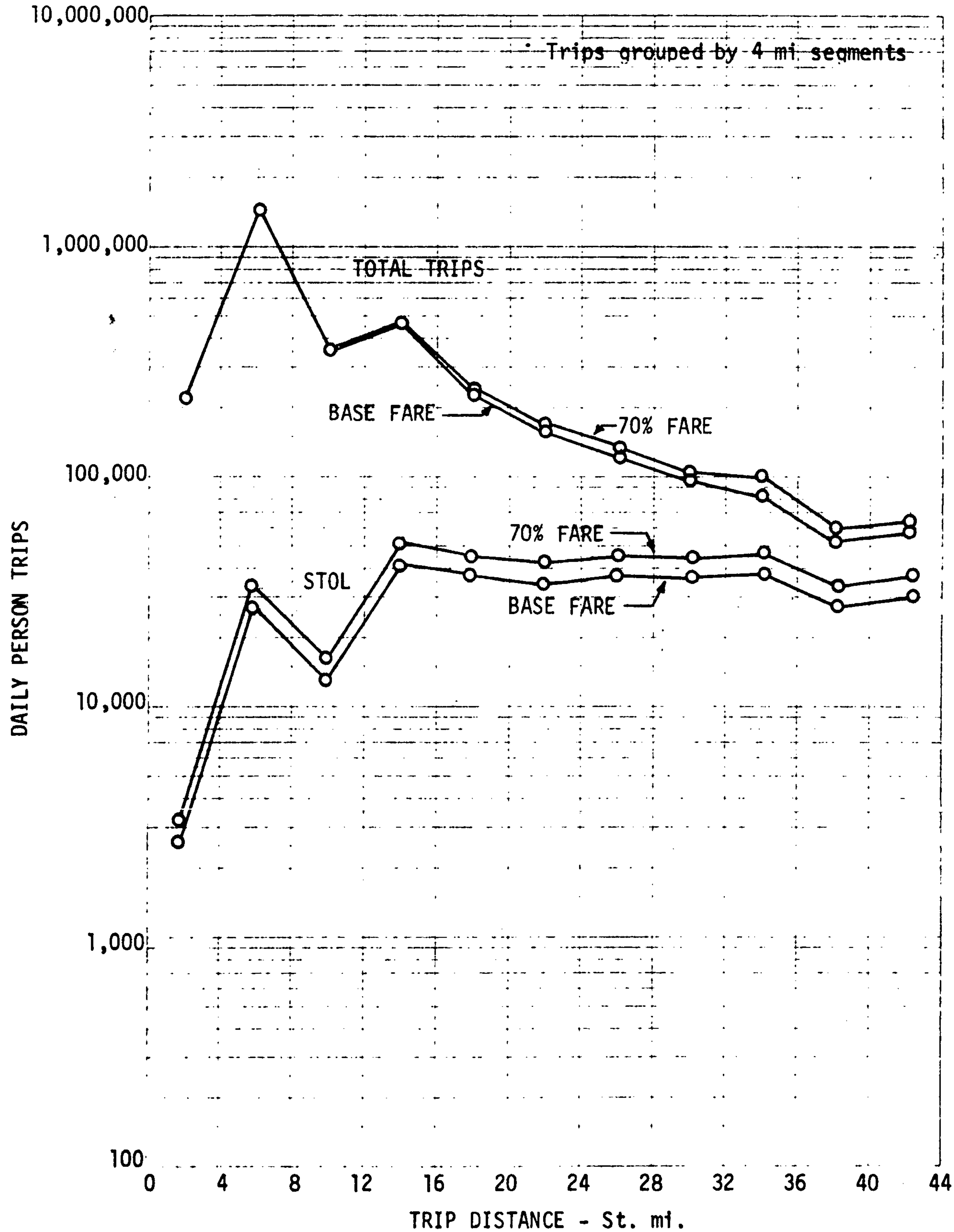


FIGURE 6.2: EFFECT OF FARE ON STOL DEMAND (1965)

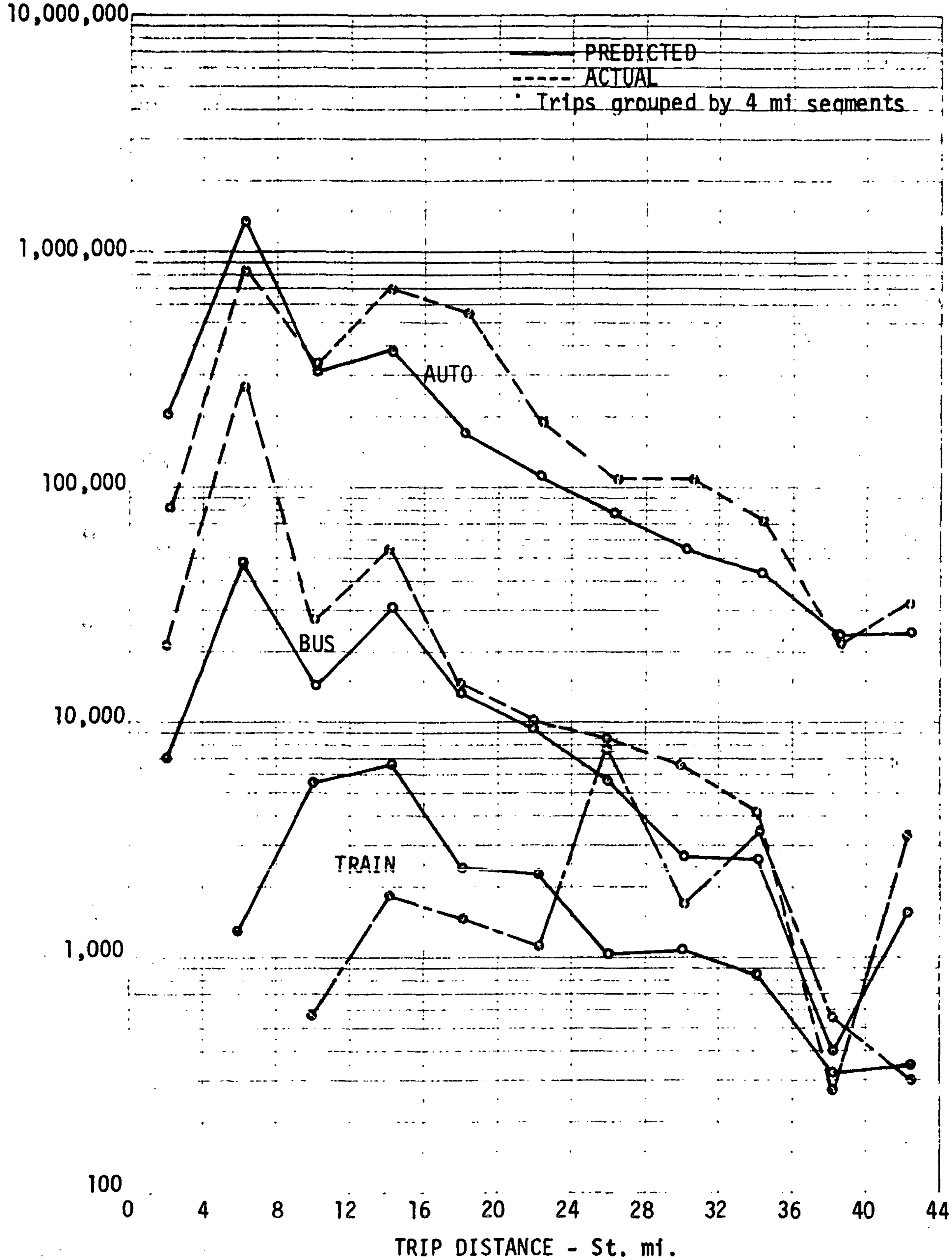


FIGURE 6.3: DEMAND MODEL PREDICTIONS vs ACTUAL TRIPS (1965)

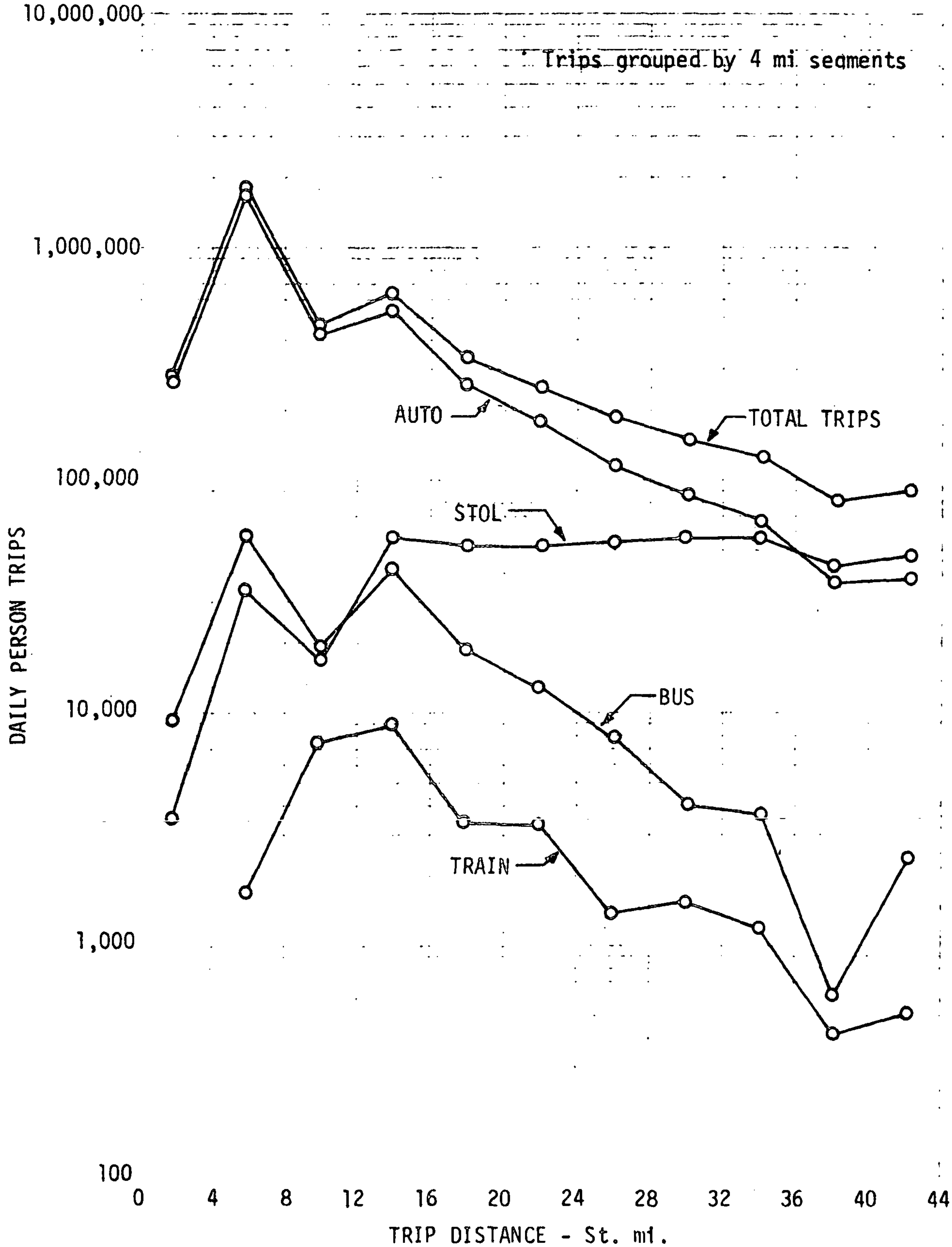


FIGURE 6.4: DEMAND MODEL RESULTS BY MODE (1980)

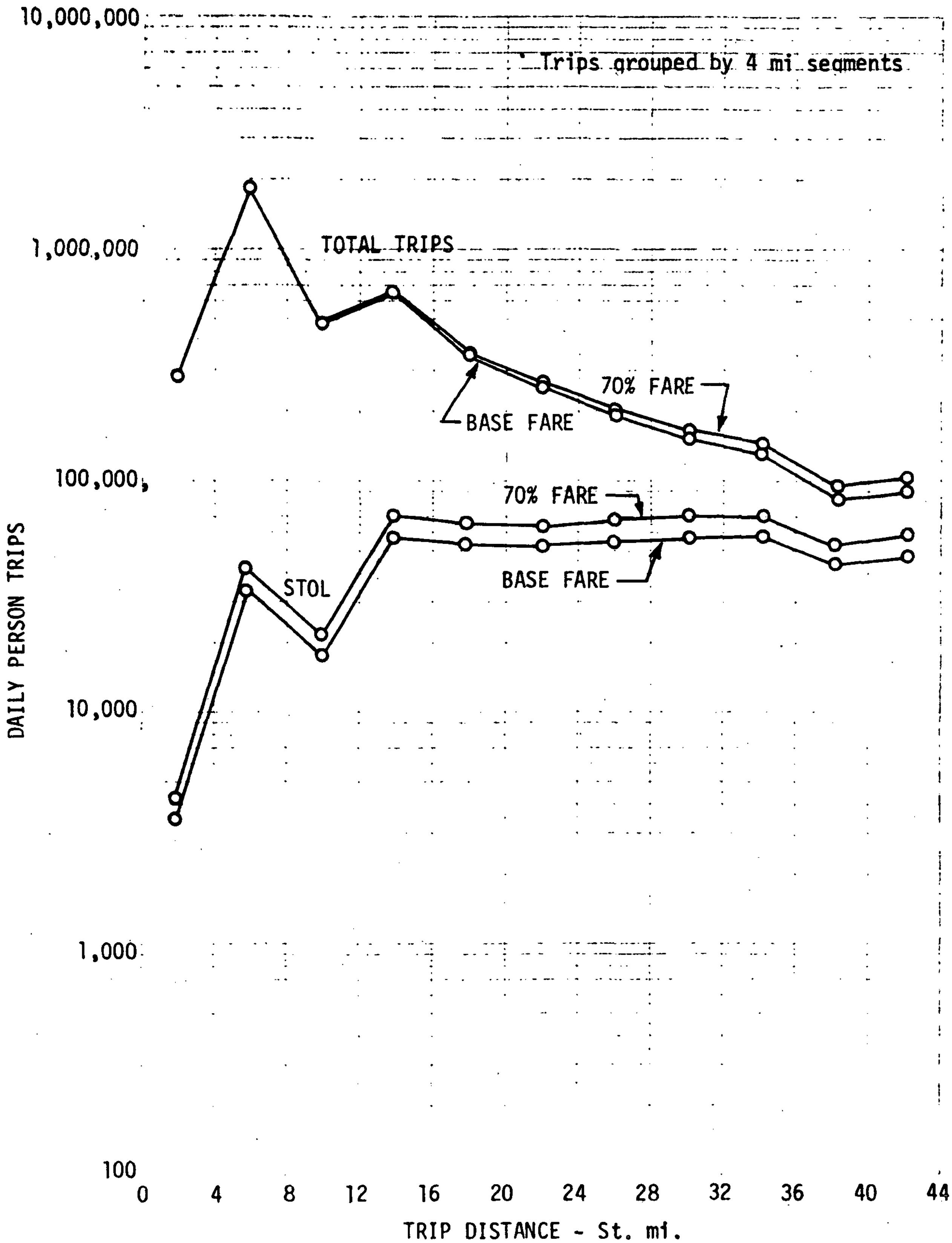


FIGURE 6.5: EFFECT OF AIR FARE ON STOL DEMAND (1980)

fare differences in 1980 and 1965 have the same effect on travel. (The fares must be expressed in constant dollars.) As in 1965, in 1980 a fare level decrease of 30% produces about a 19% increase in STOL demand.

6.2 EFFECT OF DEMAND UPON AIR SYSTEM

In the earlier intraurban study, Reference 1, aircraft and systems were evaluated by simulating the operation of the air system using the network model. Input to the network model included demand for STOL by segment. These demands were calculated by applying a rational, but uncalibrated modal split model to MTC developed tables of total travel demand.

The modal split model used depended only upon the cost and time differences between modes. Further only single occupant auto traffic was considered as potential STOL traffic. The modal split was done at the 291 zone level so that costs and times could be accurately computed.

The new model is substantially different from the earlier one. In addition to costs and times, travelers' attitudes affect modal split. Further, demand stimulation is allowed; i.e., adding a new travel mode will tend to produce more travel. Hence the new mode need not only divert old traffic, it can generate its own traffic. The old model was quite sensitive to cost, whereas the new model is quite insensitive to cost.

For this application, the new model was used on the 30 superzone level. This is less accurate than the 291 zone level at which the old model was applied. It was felt that the larger zones would be more typical of what one would use in another application where the detailed MTC data didn't exist.

Figure 6.6 shows the fare levels used for STOL. Figure 6.7 shows model results for 1980 using these fares, as well as the results of the demand model used in the intraurban study. The current model predicts less total travel at short ranges and more at long ranges. STOL demand is much higher using the new model. The trip length distribution for STOL is much flatter in the new model. The effect of fare is much less marked in the new model than in the old. Many of these effects are due to the new model's ability to generate new demand.

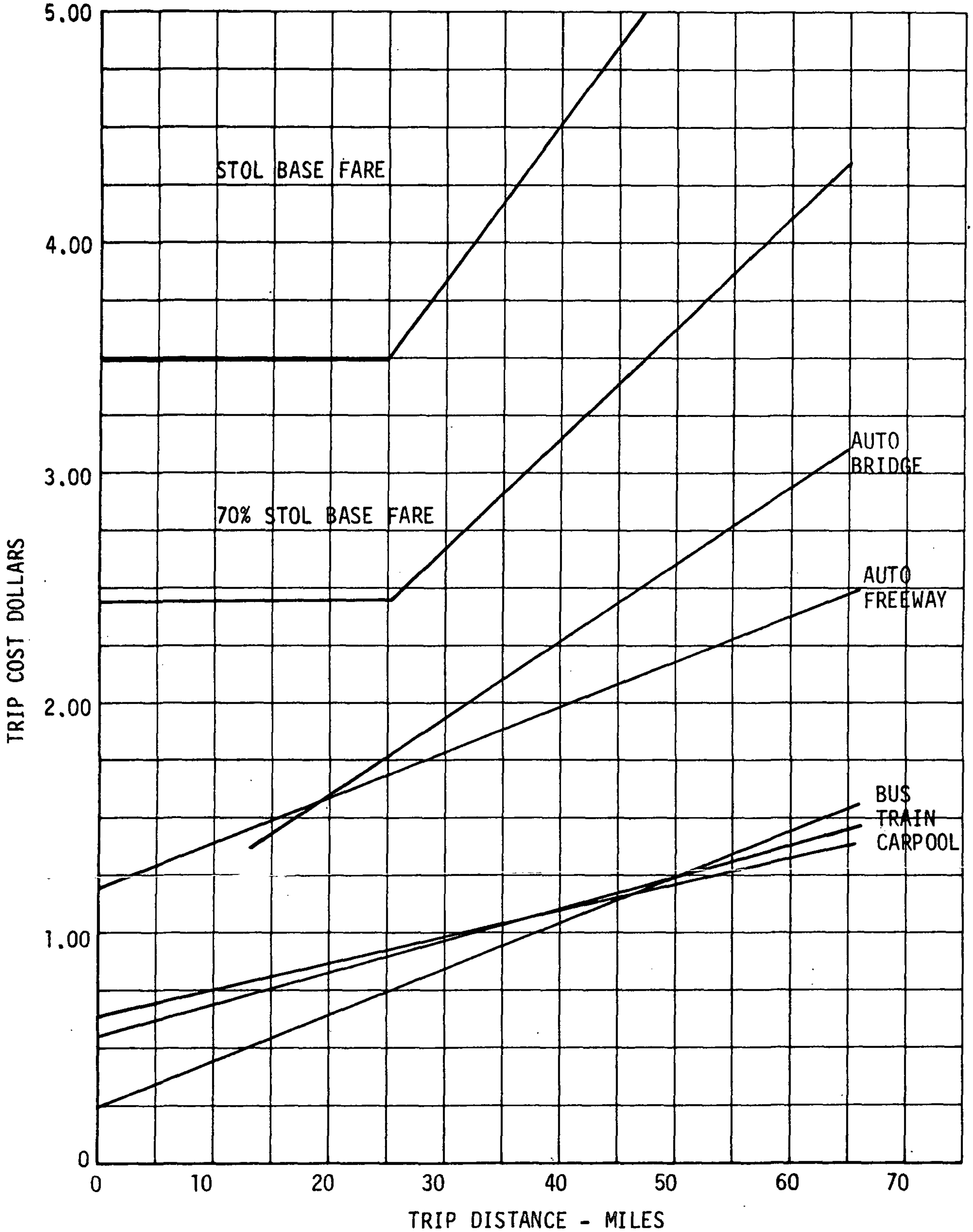


FIGURE 6.6 - TRIP COST COMPARISON WITH VARYING AIR FARE

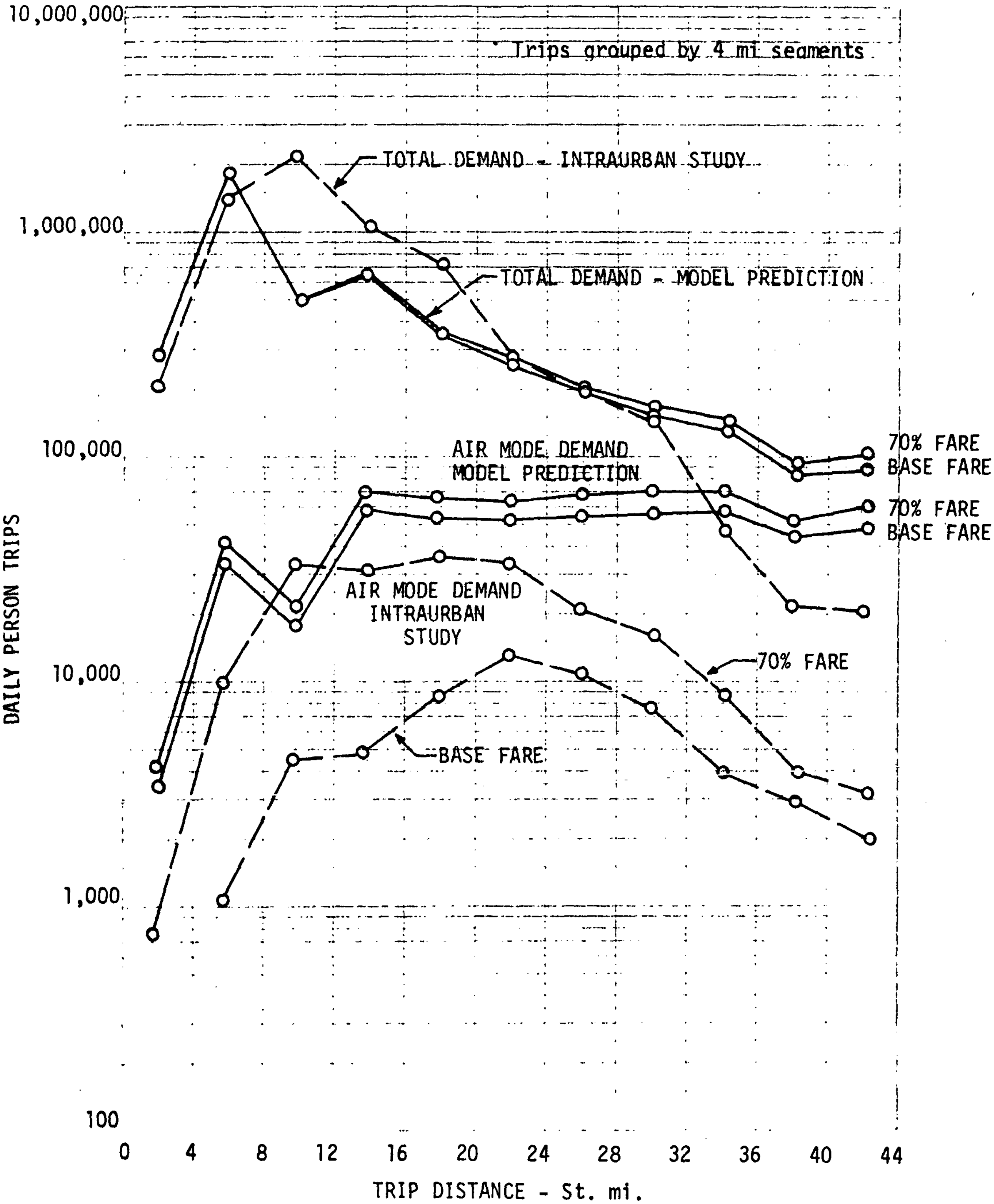


FIGURE 6.7
AIR DEMAND BY MODEL vs. INTRAURBAN STUDY (1980)

6.2.1 NETWORK MODEL INPUTS

The demand produced by the demand model was run through the network model using the STOL aircraft designed for the intraurban study. The aircraft is shown in Figure 6.8.

Model inputs other than demand were the same as those used in the intraurban study (Reference 1). Figure 6.9 shows the time of day demand curves used. The 1975 versions of the 49, 95 and 153 seat augmentor wing STOL aircraft were used. Their characteristics are as follows:

Seats	DOC intercept, \$	DOC slope, \$/st mi	Daily depreciation, \$	Daily insurance, \$	Block time intercept, min	Block time slope, min/st mi
49	34.55	0.5048	457.87	99.30	4.614	0.16226
95	45.42	0.6447	577.65	125.35	4.614	0.16226
153	61.24	0.8170	725.60	157.45	4.614	0.16226

The system imputs to the model were as follows:

- Morning curfew - 0600 hr
- Evening curfew - 2200 hr
- Target load factor - 0.5
- Gate time - 3 min.
- Passenger tolerance time - 30 min.
- Fare - \$1.75 + 0.064 (range in st mi) with \$3.50 minimum.
- IOC = 0.14458 (nodes) + 1.717 (departures)
  + 0.138723 (gates) + 0.0151 (miles flown)
  + 0.00004052 (seats) (gates) + 0.003443 (fleet)
  + 0.0233 (departures) (seats)
  + 0.125 (departures) (seats) (LF)
  + 0.0000792 (seats) (miles flown)

where

IOC = indirect operating cost in millions of dollars per year
Nodes = number of terminals in system
Departures = number of departures per year in millions
Gates = total gates in system
Seats = airplane capacity
Miles flown = total statute miles flown per year in millions
Fleet size = number of planes
LF = average load factor

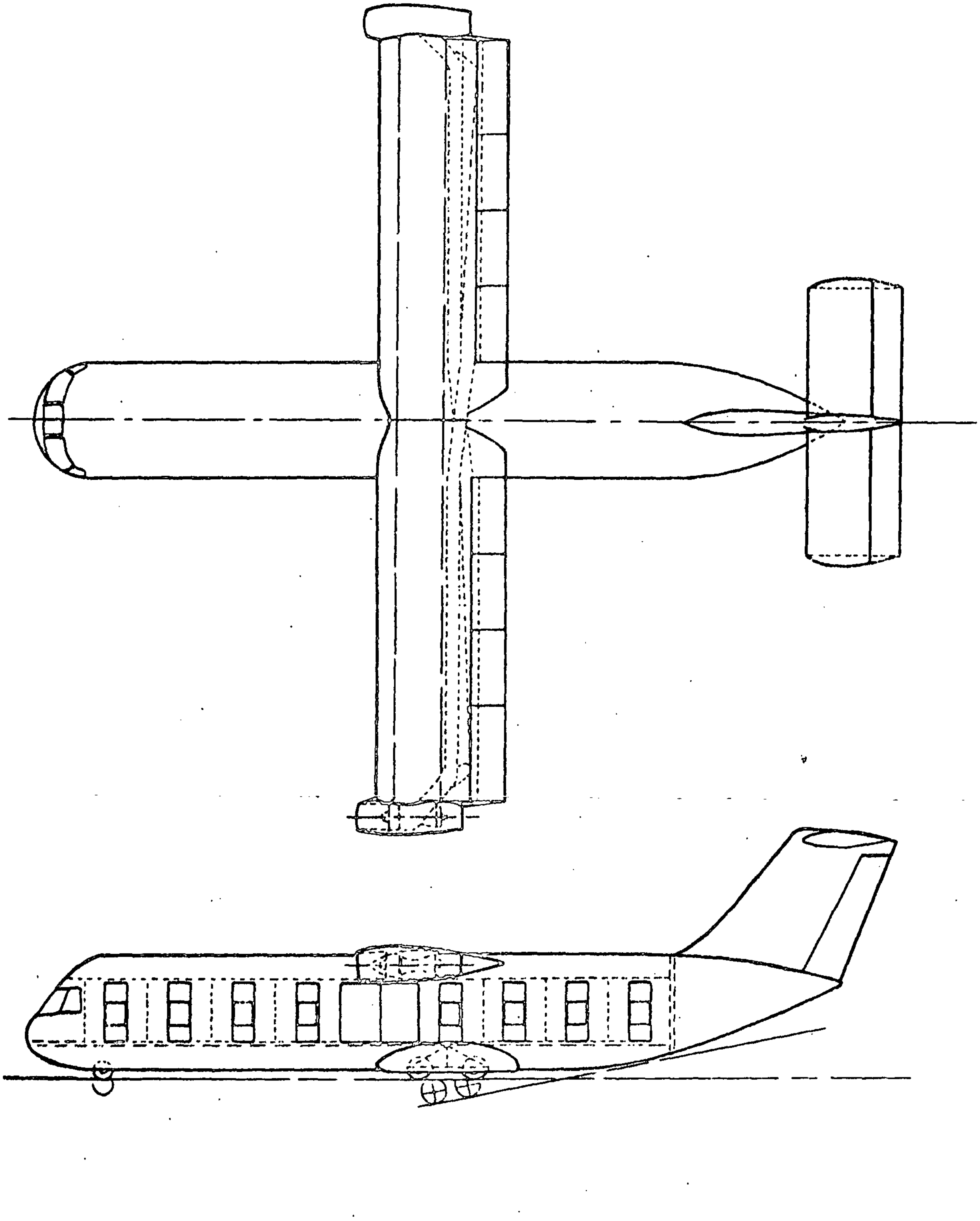


FIGURE 6.8 – 1975 AUGMENTOR WING STOL GENERAL ARRANGEMENT, 95 PASSENGERS

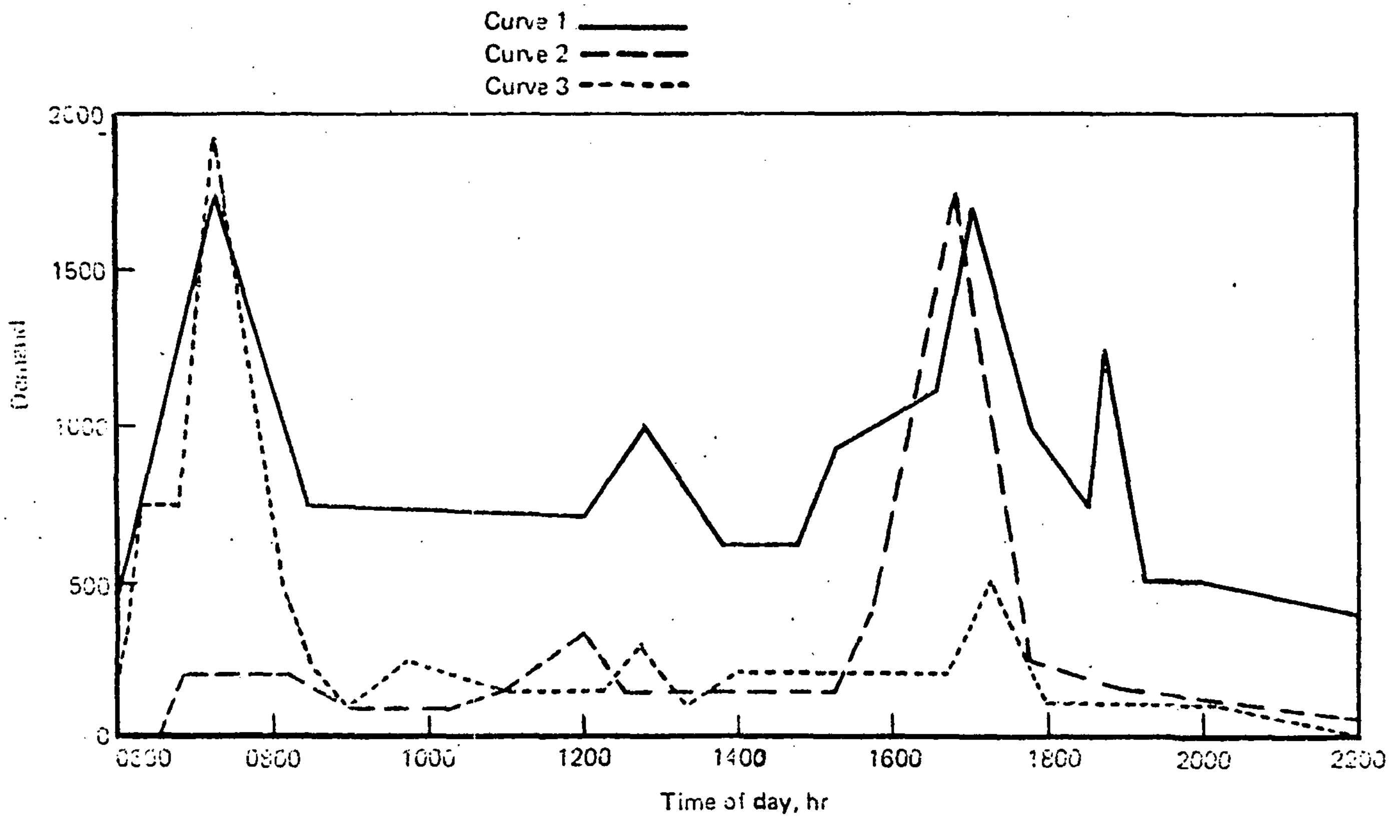


FIGURE **6.9** *—TIME-OF-DAY DEMAND*

The segment demands are shown in Table 6.1. There are a total of 226 one-way segments connecting 23 STOL ports. These consist of all segments for which the demand model predicted more than 1000 one-way passengers per day. 1000 was chosen because the previous intraurban study showed that links with fewer than 1000 passengers were not profitable. One result of including only links with 1000 passengers per day is the elimination of all but one link with trip distance over 40 miles.

The base case of the intraurban study consisted of 130 one-way segments joining 24 STOL ports. Figure 6.10 shows how that system compares with the new system. In Figure 6.10, the bottom and right-hand labels for the matrix are in the new model superzone numbers. The top and left-hand labels are for the STOLPORTS used in the intraurban study, Reference 1. The points in the matrix where both symbols appear indicate agreement between the model prediction and the previous study. Where only a circle appears, the new model did not predict sufficient traffic for air service, even though service was included in the previous study. There are a larger number of squares due to the much larger demand for STOL from the model prediction than was used in the previous study.

6.2.2 NETWORK MODEL RESULTS

Tables 6.2, 6.3 and 6.4 contain summary results from the network model for the 49, 95 and 153 seat aircraft respectively. For each aircraft type, an activity summary and a set of economic and operating statistics is given. Most of the output is self-explanatory. In the flight statistics output, FLT NBR means tail number, HRS UTIL means daily utilization in hours, PAX means daily passengers carried, WGT L.F. means distance weighted load factor, CUM PRO means cumulative profit and C. PCNT means cumulative percent of total demand carried. All costs, revenues and profits are in dollars per day and exclude investment costs.

As Tables 6.2, 6.3, and 6.4 show, each aircraft type produced an operating profit. The 95 seat aircraft is clearly the best one for the system. It generates more profit and more profit per passenger carried than the other sizes. This holds true even when the aircraft are compared at equal percent of demand carried.

Figure 6.11 shows the results of an economic analysis of the three aircraft on the new system and the same three aircraft on the old intraurban system. The figure is constructed such that daily cash flow is shown above the line and investment costs and sinking

Table 6.1 - 1980 Daily STOL Travel Demand
(Base Fare)

From	To	Distance	Direct Demand	Return Demand
1	5	10	2923	2819
	6	20	2544	2449
	7	28	2264	2152
	8	35	1867	1786
	9	40	1767	1720
	10	48	1071	1027
	13	34	1232	1135
	14	29	1729	1663
	15	19	2225	2115
	16	13	2573	2446
	17	10	3178	3094
	18	9	2691	2543
	19	11	2257	2138
	21	24	2016	1929
	23	25	1622	1501
	30	11	2352	2234
2	5	9	1345	1333
	6	21	1617	1599
	7	29	1195	1168
	15	21	1296	1267
	16	16	1264	1235
	17	12	1744	1745
	18	12	1442	1401
	19	13	1182	1150
	30	11	1173	1145

TABLE 6.1 (CONTINUED)

From	To	Distance	Direct Demand	Return Demand
3	6	18	1959	1930
	7	25	1804	1755
	8	32	1453	1423
	9	38	1354	1349
	14	27	1166	1148
	15	17	1526	1486
	16	13	1765	1718
	17	10	2238	2231
	18	11	1847	1787
	19	14	1576	1528
	21	25	1396	1368
	23	27	1220	1156
	30	14	1513	1471
4	6	19	1135	1130
	7	27	1085	1066
	8	34	1033	1022
	15	21	1048	1031
	16	17	1049	1032
	17	14	1434	1444
	18	14	1101	1076
	30	14	1277	1254
5	6	13	1422	1419
	7	21	1392	1372
	8	28	1195	1155
	9	34	1099	1110
	14	26	1129	1126
	15	19	1215	1198
	16	17	1347	1328
	17	15	1567	1582
	18	18	1253	1227
	19	21	1306	1282
	30	20	1215	1196

TABLE 6.1 (CONTINUED)

From	To	Distance	Direct Demand	Return Demand
6	8	15	1402	1321
	9	22	1380	1396
	11	28	1097	1076
	14	17	1429	1428
	15	15	1366	1350
	16	18	1375	1358
	17	20	1733	1457
	18	24	1408	1146
	19	29	1056	1039
	30	32	1084	1070
7	8	7	1362	1371
	9	13	1521	1557
	10	21	1089	1099
	11	19	1224	1216
	14	12	1519	1538
	15	17	1402	1402
	16	22	1380	1380
	17	25	1599	1638
	18	30	1153	1147
8	9	7	1538	1565
	10	14	1173	1176
	14	14	1336	1344
	15	22	1022	1016
	16	28	1009	1003
	17	31	1271	1293
9	10	8	1215	1197
	12	30	1339	1343
	14	15	1399	1682
	15	26	1210	1182
	16	32	1289	1259
	17	35	1303	1303

TABLE 6.1 (CONTINUED)

From	To	Distance	Direct Demand	Return Demand
10	12	22	1179	1201
11	14	17	1057	1076
13	14	12	1042	1089
14	15	11	1056	1044
	16	18	1102	1089
	17	22	1360	1377
15	17	11	1375	1408
	18	15	1114	1107
16	18	9	1112	1105
	19	14	1211	1206
	21	15	1097	1104
	30	23	1084	1083
17	19	10	1272	1237
	21	15	1340	1317
	23	22	1328	1262
	24	37	1076	1053
	30	18	1610	1571
18	21	14	1002	1014
	23	17	1117	1094
	30	15	1009	1026
19	21	15	1071	1082
	23	13	1029	1005
	30	12	1084	1087
21	24	24	1039	1034
23	24	18	1064	1095

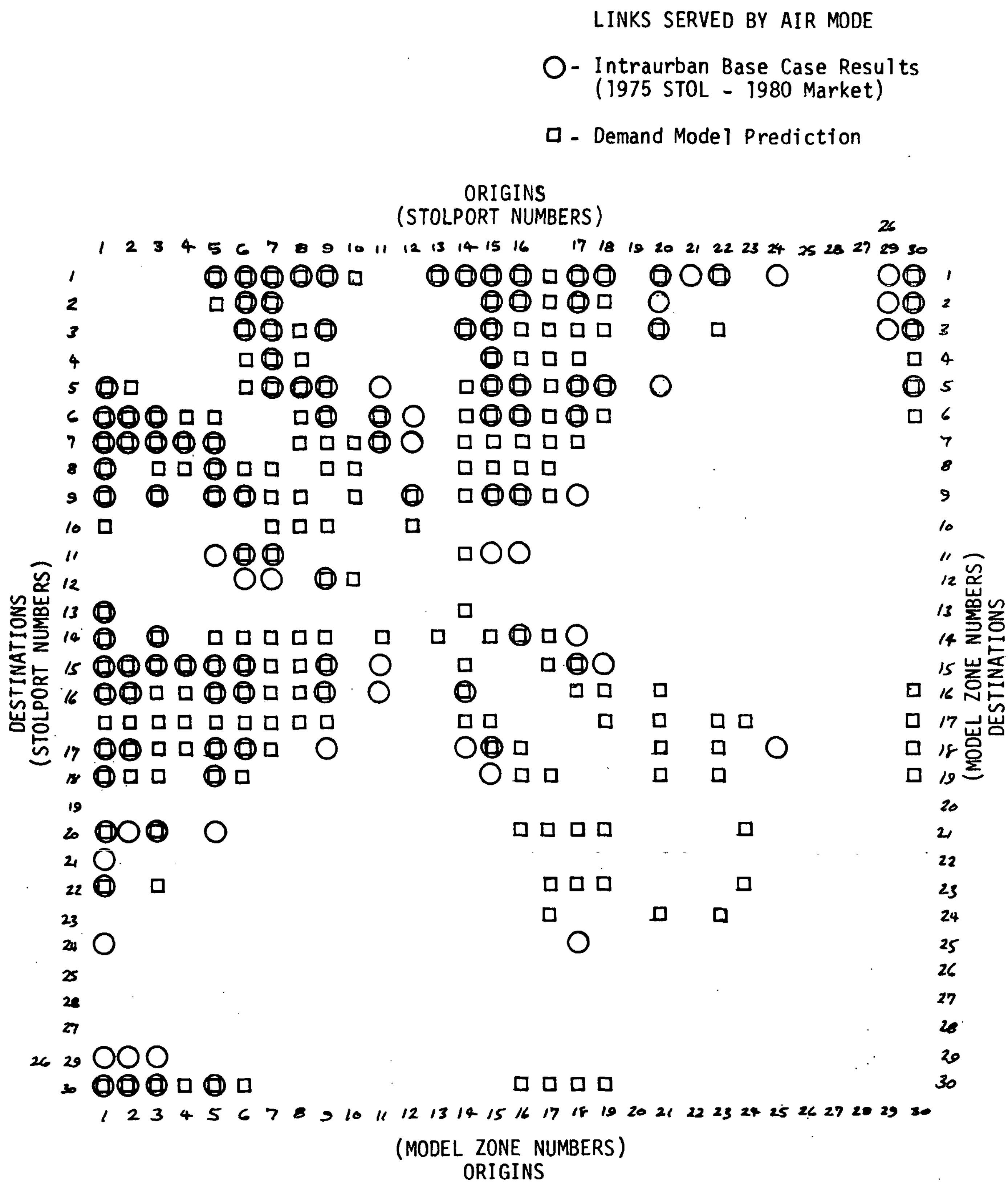


FIGURE 6.10: ROUTE STRUCTURE COMPARISON (1980)

TABLE 6.2
NETWORK MODEL RESULTS
49 SEAT AUGMENTOR WING STOL

FLIGHT STATISTICS

FLT NBR	HRS UTIL	PAX	WGT L.F.	L.F.	DISTANCE	REVENUE	DOC	IOC	PROFIT	CUM PRO	C.PCNT
1	9.17	3112	.788	.734	1085.7	10890.34	3903.79	0.00	6986.54	6987	.0098
2	8.27	2429	.763	.750	1210.8	8471.60	3414.15	0.00	5057.45	12044	.0174
3	8.39	2757	.822	.815	1142.0	9643.61	3517.58	0.00	6131.03	18175	.0261
4	9.35	3212	.856	.851	1268.9	11265.68	3858.06	0.00	7411.62	25587	.0362
5	9.13	2424	.776	.735	1586.2	8853.42	3534.55	0.00	5324.88	30912	.0439
6	5.53	1492	.730	.731	955.3	5441.47	2386.83	0.00	3054.63	33966	.0486
7	9.37	2433	.772	.766	1616.7	8851.99	3619.02	0.00	5232.97	39199	.0562
8	9.73	2567	.760	.770	1312.5	9082.50	3569.11	0.00	5513.39	44713	.0643
9	8.38	2673	.794	.791	1135.8	9375.49	3514.47	0.00	5861.32	50574	.0727
10	8.62	2997	.869	.874	1271.7	10560.09	3617.64	0.00	6942.45	57516	.0822
11	9.76	2533	.773	.784	1731.6	9302.95	3711.46	0.00	5591.47	63107	.0901
12	9.38	3013	.812	.820	1337.7	10556.56	3823.68	0.00	6732.88	69840	.0996
13	8.64	2875	.777	.772	1034.0	10063.21	3704.95	0.00	6358.26	76199	.1087
14	9.36	3143	.854	.867	1357.7	11052.72	3799.23	0.00	7253.49	83452	.1186
15	9.28	2847	.778	.785	1328.9	10007.64	3784.70	0.00	6222.93	89675	.1276
16	9.53	3426	.849	.842	1152.6	12014.00	4006.65	0.00	8007.35	97682	.1384
17	5.75	2976	.864	.869	984.4	10421.90	3472.58	0.00	6949.32	104632	.1477
18	9.59	3285	.864	.871	1209.4	11580.84	3828.04	0.00	7752.80	112384	.1581
19	9.82	2881	.865	.865	1404.4	10197.17	3615.53	0.00	6581.65	118966	.1672
20	9.82	2701	.796	.799	1606.6	9660.46	3783.41	0.00	5877.05	124843	.1757
21	9.43	2956	.833	.838	1460.3	10646.44	3781.91	0.00	6864.52	131708	.1853
22	9.41	3373	.870	.873	1232.0	11893.69	3948.54	0.00	7945.15	139653	.1956
23	8.24	2901	.838	.846	1055.6	10163.52	3508.56	0.00	6654.96	146308	.2047
24	9.89	2821	.832	.836	1837.1	9777.14	3695.74	0.00	6081.40	152389	.2130
25	9.40	2729	.817	.819	1562.8	9748.01	3695.47	0.00	6052.54	158442	.2216
26	9.63	2723	.851	.855	1713.7	9761.90	3668.01	0.00	6113.89	164556	.2302
27	9.32	2641	.801	.804	1540.8	9454.09	3649.83	0.00	5804.26	170360	.2385
28	9.29	2750	.868	.850	1557.3	9925.48	3623.61	0.00	6301.86	176662	.2471
29	8.46	2475	.813	.815	1365.7	8738.10	3388.69	0.00	5349.41	182011	.2549
30	8.38	2911	.895	.900	1223.2	10188.13	3454.93	0.00	6733.20	188744	.2641
31	8.93	3051	.900	.889	1186.5	10677.11	3574.61	0.00	7102.51	195847	.2737
32	9.51	2736	.816	.833	1242.7	9694.44	3499.32	0.00	6195.12	202042	.2823
33	9.47	2743	.823	.823	1197.8	9666.17	3511.22	0.00	6154.95	208197	.2910
34	9.70	3283	.859	.848	1342.1	11504.64	3964.13	0.00	7540.52	215737	.3013
35	8.33	2649	.852	.856	1289.3	9286.38	3384.66	0.00	5901.73	221639	.3097
36	9.63	3185	.854	.862	1307.0	11130.02	3808.21	0.00	7321.81	228961	.3196
37	9.13	2952	.885	.876	1459.9	10250.56	3609.00	0.00	6641.57	235603	.3287
38	5.48	2749	.809	.813	1174.1	9678.97	3533.79	0.00	6145.19	241748	.3374
39	9.60	2694	.815	.808	1417.3	9446.20	3622.04	0.00	5824.15	247572	.3459
40	8.65	2922	.851	.852	1212.6	10230.50	3587.77	0.00	6642.72	254215	.3551
41	8.92	3233	.845	.849	1109.3	11213.17	3777.49	0.00	7435.69	261650	.3652
42	7.74	2625	.855	.850	1070.5	9199.15	3274.19	0.00	5924.95	267575	.3734
43	7.51	2734	.901	.900	1012.9	9569.39	3210.57	0.00	6358.82	273934	.3820
44	7.45	2615	.819	.847	966.4	9181.35	3221.64	0.00	5959.70	279894	.3903
45	8.53	3035	.852	.849	1227.1	10667.66	3698.74	0.00	6968.92	286863	.3998
46	9.28	2883	.845	.854	1389.9	10228.42	3642.75	0.00	6585.67	293448	.4089
47	7.57	2647	.855	.856	1067.1	9272.55	3242.23	0.00	6030.32	299479	.4173
48	9.23	3123	.829	.838	1239.6	10974.29	3608.73	0.00	7165.56	306644	.4271
49	8.69	3015	.871	.854	1165.1	10643.01	3632.89	0.00	7010.12	313654	.4366
50	9.23	2602	.780	.793	1137.9	9173.51	3446.41	0.00	5727.10	319381	.4448
51	6.62	2383	.854	.884	883.2	8381.02	2903.25	0.00	5477.78	324859	.4523
52	8.76	2873	.832	.826	1196.5	10170.85	3614.21	0.00	6556.65	331416	.4613
53	8.78	2391	.836	.827	831.0	8416.29	3015.10	0.00	5391.19	336807	.4689
54	8.39	2792	.845	.851	1037.8	9854.62	3421.16	0.00	6433.46	343241	.4777
55	6.70	2464	.886	.882	856.1	8624.54	2958.68	0.00	5665.86	348906	.4854

TABLE 6.2 (CONTINUED)

56	5.80	1951	.852	.347	839.8	6860.35	2639.49	0.00	4221.06	353127	.4916
57	6.14	2616	.838	.348	1216.9	9243.12	3348.09	0.00	5897.34	359025	.4998
58	9.14	3200	.822	.327	1133.9	11240.15	3858.99	0.00	7381.16	366406	.5099
59	7.29	2460	.836	.351	1016.8	8743.68	3108.90	0.00	5634.78	372041	.5176
60	9.05	3140	.849	.366	1240.5	11052.57	3740.07	0.00	7312.50	379354	.5275
61	8.31	2708	.855	.364	1141.3	9550.93	3344.50	0.00	6206.43	385560	.5360
62	7.95	2540	.833	.336	1177.2	9042.19	3293.53	0.00	5748.56	391309	.5440
63	6.57	2179	.833	.339	956.8	7679.16	2905.85	0.00	4774.01	396083	.5509
64	8.85	3019	.856	.380	1283.2	10794.08	3623.41	0.00	7170.67	403253	.5604
65	7.97	2632	.850	.353	1156.0	9300.22	3317.37	0.00	5982.85	409236	.5687
66	8.37	2622	.746	.776	1131.6	9259.13	3512.33	0.00	5747.03	414983	.5773
67	8.36	2650	.864	.332	1241.2	9351.50	3429.48	0.00	5922.02	420905	.5853
68	7.47	2419	.815	.323	1055.2	8602.39	3162.83	0.00	5439.56	426345	.5929
69	5.93	1606	.776	.782	943.4	6201.59	2553.58	0.00	3647.01	429993	.5982
70	7.12	2391	.851	.871	1140.9	8725.42	3171.54	0.00	5553.86	435547	.6058
71	8.61	2630	.874	.375	1307.4	10251.53	3497.45	0.00	6754.07	442301	.6147
72	7.47	2356	.848	.358	1170.2	8403.58	3082.66	0.00	5320.92	447622	.6221
73	6.12	1772	.778	.769	925.5	6328.19	2648.24	0.00	3679.86	451301	.6277
74	7.94	2392	.816	.327	1256.7	8496.31	3230.01	0.00	5266.30	456569	.6352
75	7.47	2366	.831	.847	1140.3	8442.44	3102.16	0.00	5340.28	461908	.6427
76	7.41	2362	.896	.376	1175.6	8325.61	3050.84	0.00	5274.77	467183	.6501
77	6.57	2140	.854	.356	979.2	7601.94	2813.50	0.00	4788.44	471972	.6568
78	7.16	2114	.853	.846	1199.0	7558.38	2924.48	0.00	4634.39	476606	.6635
79	6.92	1957	.848	.850	1223.5	7190.33	2798.64	0.00	4392.30	480998	.6697
80	6.39	1975	.848	.358	1027.7	7068.31	2699.62	0.00	4368.69	485367	.6759
81	6.54	1837	.801	.798	1228.1	6708.11	2800.97	0.00	3907.04	489274	.6817
82	7.85	2187	.799	.811	1372.2	7972.26	3184.65	0.00	4787.60	494062	.6886
83	6.58	2023	.827	.845	1038.6	7401.14	2774.42	0.00	4626.62	498689	.6950
84	5.46	1639	.837	.846	851.7	6124.93	2403.66	0.00	3721.27	502410	.7003
85	4.16	1296	.733	.802	668.0	4683.59	2103.62	0.00	2579.96	504990	.7044
86	4.32	1267	.737	.760	629.0	4552.77	2049.38	0.00	2503.39	507493	.7084
87	4.13	1145	.790	.779	692.4	4143.12	1943.17	0.00	2195.85	509690	.7120
88	6.93	1853	.773	.756	1164.2	6833.55	2872.33	0.00	3961.22	513651	.7178
89	5.43	1354	.716	.708	897.1	4871.32	2357.50	0.00	2513.83	516165	.7221
90	5.60	1433	.786	.770	990.5	5193.42	2370.09	0.00	2823.33	518989	.7266
91	6.16	1627	.800	.791	1082.1	5968.22	2554.53	0.00	3413.69	522402	.7317
92	4.91	1073	.723	.684	756.2	3950.05	2044.52	0.00	1905.53	524308	.7351
93	5.62	1493	.769	.764	939.0	5470.26	2413.16	0.00	3057.10	527365	.7392
94	3.34	829	.740	.736	612.5	3032.48	1695.55	0.00	1336.93	528702	.7424
95	4.35	1229	.723	.757	736.9	4365.49	2138.41	0.00	2227.07	530929	.7463
96	4.75	1292	.746	.751	691.0	4571.21	2285.32	0.00	2285.89	533215	.7502
97	4.76	1278	.779	.767	625.7	4670.43	2183.21	0.00	2487.22	535702	.7542
98	4.83	1323	.815	.792	840.3	4792.61	2156.07	0.00	2636.54	538339	.7584
99	4.70	1434	.786	.770	655.6	5064.62	2200.39	0.00	2863.63	541202	.7629
100	4.02	1041	.641	.685	604.1	3682.98	1933.14	0.00	1749.83	542952	.7662
101	4.34	1112	.777	.732	791.4	4000.61	2096.80	0.00	1903.81	544856	.7697
102	3.64	883	.659	.643	550.8	3111.23	1802.61	0.00	1308.62	546164	.7725
103	3.45	1005	.732	.759	542.3	3554.32	1798.32	0.00	1756.00	547920	.7757
104	4.19	1012	.690	.666	667.5	3628.92	1965.18	0.00	1663.74	549584	.7788
105	3.92	837	.601	.610	718.5	3068.74	1956.36	0.00	1112.38	550697	.7815
106	3.58	852	.606	.621	725.8	2990.48	2098.24	0.00	892.24	551589	.7842
107	2.80	812	.679	.721	637.6	2851.72	1915.52	0.00	936.20	552525	.7867
108	3.53	886	.644	.670	760.3	3136.53	2115.67	0.00	1020.96	553546	.7895
109	3.35	871	.662	.658	702.1	3050.75	2086.27	0.00	964.48	554510	.7923
110	4.14	1183	.707	.735	826.0	4172.06	2356.15	0.00	1815.86	556326	.7960
111	2.91	612	.613	.624	638.3	2139.94	1708.57	0.00	481.37	556808	.7979
112	3.14	731	.625	.597	549.3	2614.52	1801.88	0.00	812.64	557620	.8002

TABLE 6.2 (CONTINUED)

113	2.15	651	.750	.738	516.3	227[illegible].13	1681.57	0.00	596.56	558217	.8023
114	2.33	612	.662	.557	488.9	215[illegible].24	1633.15	0.00	519.08	558736	.8042
115	2.43	628	.708	.712	619.2	2225.69	1733.48	0.00	492.21	559228	.8062
116	2.86	774	.659	.752	627.8	2755.20	1772.36	0.00	982.84	560211	.8086
117	2.92	660	.618	.512	654.3	2339.77	1854.87	0.00	484.90	560696	.8107
118	2.66	662	.623	.543	726.2	2404.62	1925.69	0.00	478.93	561175	.8128
119	2.81	574	.562	.557	476.6	2045.30	1557.85	0.00	487.44	561662	.8146
120	2.45	651	.637	.565	605.0	2305.94	1829.95	0.00	475.98	562138	.8166
121	2.84	679	.574	.577	568.7	2384.34	1880.76	0.00	503.58	562642	.8188
122	3.36	595	.398	.419	418.7	2085.64	1770.49	0.00	315.15	562957	.8206
123	2.40	578	.484	.521	611.6	2045.35	1758.73	0.00	246.62	563204	.8225
124	3.49	732	.488	.533	727.5	259[illegible].00	2133.66	0.00	457.34	563661	.8248
125	2.35	651	.650	.599	640.0	2322.13	1947.65	0.00	474.48	564135	.8268
126	3.23	767	.555	.542	804.8	2837.84	2172.70	0.00	665.13	564801	.8293
127	2.97	373	.466	.475	406.6	1342.21	1419.87	0.00	-77.65	564723	.8305
128	2.80	756	.669	.701	640.5	2668.55	1882.43	0.00	786.12	565509	.8329
129	2.83	711	.574	.505	726.6	2547.11	2134.23	0.00	412.87	565922	.8351
130	3.16	678	.478	.532	759.5	2379.30	2184.39	0.00	194.91	566117	.8372
131	3.72	667	.426	.469	849.0	2348.87	2298.64	0.00	50.24	566167	.8393
132	2.14	478	.502	.516	570.4	172[illegible].43	1639.76	0.00	81.67	566249	.8408
133	2.55	410	.401	.398	500.0	1464.82	1788.66	0.00	-323.84	565925	.8421
134	2.16	643	.686	.772	715.0	228[illegible].86	1920.06	0.00	360.80	566286	.8442
135	1.96	480	.631	.512	470.4	168[illegible].61	1554.74	0.00	133.86	566419	.8457
136	3.42	559	.496	.439	691.0	2012.96	1977.02	0.00	35.29	566455	.8474
137	2.52	441	.533	.450	675.9	170[illegible].72	1762.13	0.00	-60.41	566395	.8488
138	2.19	377	.593	.512	548.0	143[illegible].86	1524.78	0.00	-93.91	566301	.8500
139	2.55	425	.454	.579	532.2	1543.11	1551.39	0.00	-8.28	566293	.8513
140	2.31	492	.659	.591	668.6	1852.33	1792.99	0.00	59.33	566352	.8529
141	2.65	542	.585	.582	706.9	2058.36	1846.85	0.00	211.51	566564	.8542
142	2.12	358	.591	.487	524.5	1399.22	1512.93	0.00	-113.71	566450	.8557
143	1.18	219	.661	.560	342.5	856.75	1144.64	0.00	-287.89	566162	.8564
144	1.90	568	.839	.800	640.7	2161.95	1778.91	0.00	383.04	566545	.8583
145	2.61	410	.537	.465	554.3	1557.31	1562.54	0.00	-5.23	566540	.8596
146	2.07	539	.688	.588	644.2	1955.46	1780.66	0.00	174.80	566715	.8613
147	2.24	575	.573	.552	648.9	2025.06	1852.15	0.00	172.91	566888	.8631
148	3.80	426	.354	.322	729.4	1506.65	2030.99	0.00	-524.33	566363	.8644
149	2.35	301	.316	.323	361.8	1053.54	1430.80	0.00	-377.27	565986	.8654
150	1.77	545	.677	.795	555.9	1924.52	1632.45	0.00	292.17	566278	.8671
151	1.93	549	.594	.700	542.6	1948.67	1660.29	0.00	288.38	566566	.8688
152	1.25	207	.381	.422	278.6	732.42	1146.95	0.00	-414.53	566152	.8695
153	2.39	451	.434	.484	609.7	158[illegible].71	1797.81	0.00	-216.10	565936	.8709
154	2.98	427	.349	.379	613.8	1505.68	1834.42	0.00	-328.75	565607	.8722
155	2.41	350	.396	.421	506.2	127[illegible].16	1503.71	0.00	-232.55	565375	.8733
156	1.77	405	.560	.636	515.9	1455.06	1508.62	0.00	-53.56	565321	.8746
157	1.96	538	.613	.686	601.2	1896.58	1758.97	0.00	137.61	565459	.8763
158	1.76	229	.437	.389	375.5	87[illegible].27	1230.42	0.00	-353.15	565105	.8770
159	2.64	431	.567	.586	627.5	1593.30	1703.11	0.00	-110.11	564995	.8784
160	2.30	222	.337	.267	434.9	846.30	1433.15	0.00	-586.86	564408	.8791
161	1.65	358	.470	.522	551.7	127[illegible].69	1595.75	0.00	-324.05	564084	.8802
162	2.14	346	.499	.470	565.6	129[illegible].33	1568.22	0.00	-276.35	563808	.8813
163	2.09	323	.456	.440	545.1	115[illegible].65	1557.89	0.00	-400.64	563408	.8823
164	1.55	279	.580	.518	427.0	100[illegible].21	1325.54	0.00	-318.33	563090	.8832
165	1.63	322	.664	.597	523.5	120[illegible].70	1443.31	0.00	-241.61	562848	.8842
166	1.74	307	.620	.522	500.9	119[illegible].34	1431.92	0.00	-233.58	562614	.8852
167	1.13	224	.675	.653	384.4	935.38	1165.80	0.00	-230.42	562384	.8859
168	1.37	253	.743	.645	445.2	110[illegible].70	1231.07	0.00	-129.37	562255	.8867
169	1.45	283	.711	.722	474.9	126[illegible].11	1246.04	0.00	19.07	562274	.8876

TABLE 6.2 (CONTINUED)

170	1.25	313	.793	.798	432.4	1240.84	1259.13	0.00	21.71	562295	.8885
171	1.82	312	.664	.579	556.4	1219.62	1426.38	0.00	-126.76	562159	.8895
172	1.71	316	.656	.590	516.9	1215.60	1405.47	0.00	-139.87	562025	.8905
173	1.39	355	.648	.305	486.8	1350.97	1356.70	0.00	4.27	562033	.8916
174	1.12	299	.792	.371	415.8	1106.33	1216.22	0.00	-69.22	561963	.8926
175	1.17	290	.790	.740	403.1	1110.34	1244.34	0.00	-144.00	561819	.8935
176	1.03	259	.690	.756	380.5	972.33	1198.41	0.00	-226.07	561593	.8943
177	1.05	287	.744	.336	387.3	1036.19	1201.83	0.00	-165.65	561428	.8952
178	1.08	262	.638	.569	337.4	925.10	1176.62	0.00	-251.51	561176	.8960
179	.99	229	.590	.569	334.2	811.70	1140.46	0.00	-328.77	560847	.8968
180	.94	256	.648	.747	316.0	913.55	1131.29	0.00	-227.74	560619	.8976
181	1.21	279	.608	.534	359.0	915.42	1222.12	0.00	-236.70	560383	.8985
182	.99	225	.437	.557	332.1	735.41	1139.41	0.00	-344.00	560039	.8992
183	1.03	267	.502	.561	320.0	913.18	1167.87	0.00	-224.70	559814	.9000
184	.85	238	.546	.593	281.7	832.50	1113.96	0.00	-281.46	559533	.9008
185	.83	226	.515	.559	296.9	710.66	1121.67	0.00	-331.00	559202	.9015
186	.87	212	.433	.517	287.4	712.47	1116.87	0.00	-374.40	558827	.9021
187	.75	279	.519	.314	276.5	977.61	1145.92	0.00	-168.31	558659	.9032
188	.79	267	.477	.777	292.7	938.99	1154.06	0.00	-215.02	558444	.9039
189	.68	214	.482	.726	246.9	748.97	1061.85	0.00	-312.88	558131	.9045
190	.66	206	.452	.700	239.0	720.74	1057.89	0.00	-337.15	557794	.9052

TABLE 6.2 (CONCLUDED)

DAILY SUMMARY

Mean utilization, hours	5.10
Standard deviation of utilization, hours	3.06
Load factor	.77
Total passengers carried	287,404.
Total direct operating cost, dollars	465,626.
Total indirect operating cost, dollars	121,884.
Total revenue, dollars	1,023,420.
Total profit, dollars	435,910.
Mean passenger wait time, min.	12.90
Total demand	317,513.
Percent demand carried	90.52
Total revenue flights	7,489.
Total distance flown, miles	163,157.
Total revenue passenger miles flown	5,520,050.
Number ferry flights	540.
Total distance ferried, miles	17,231.
Profit per passenger, dollars	1.52
Fleet size	190
Total gates required	110

TABLE 6.3
NETWORK MODEL RESULTS
95 SEAT AUGMENTOR WING STOL

FLIGHT STATISTICS

FLT NBR	HRS UTIL	PAX	WGT L.F.	L.F.	DISTANCE	REVENUE	DOC	ICC	PROFIT	CUM PRO	C.PCNT
1	7.41	3925	.675	.677	1005.5	13733.68	4121.36	0.00	9612.32	9612	.0124
2	8.21	3339	.641	.652	1271.0	13613.74	4339.47	0.00	9281.27	18893	.0245
3	9.12	4503	.695	.678	1380.2	16140.01	4772.23	0.00	11367.78	30260	.0387
4	7.51	3587	.638	.640	1096.0	12563.41	4090.69	0.00	8472.72	38764	.0495
5	7.59	4079	.675	.671	1119.1	14437.63	4331.40	0.00	10106.23	48872	.0623
6	8.02	4292	.696	.710	1286.2	15252.23	4393.65	0.00	10858.58	59730	.0762
7	8.51	4249	.679	.688	1113.0	14950.23	4372.56	0.00	10577.38	70308	.0896
8	7.60	4079	.664	.682	1092.8	14386.38	4266.97	0.00	10119.41	80427	.1024
9	8.26	4533	.665	.662	1072.9	15914.16	4574.10	0.00	11340.06	91767	.1167
10	8.62	4737	.675	.702	1243.6	15723.89	4729.59	0.00	10994.30	103765	.1316
11	7.21	3772	.661	.665	1017.9	13271.72	3993.01	0.00	9277.11	113045	.1433
12	8.15	4141	.653	.703	1249.9	14704.75	4324.85	0.00	10379.90	123425	.1562
13	6.72	3136	.646	.647	1035.3	11075.92	3686.89	0.00	7389.03	130814	.1654
14	8.44	4338	.700	.692	1243.6	15265.05	4502.59	0.00	10762.46	141576	.1791
15	8.25	4246	.723	.735	1405.0	14777.42	4243.16	0.00	10534.26	152110	.1924
16	8.84	4376	.753	.753	908.9	14269.78	3877.89	0.00	10391.50	162502	.2057
17	8.24	3860	.697	.603	1257.3	14318.33	4375.05	0.00	9943.28	172445	.2182
18	7.55	4012	.766	.762	1403.5	14566.59	4060.50	0.00	10506.08	182952	.2316
19	8.11	4303	.721	.714	1322.9	14271.66	4235.65	0.00	10036.01	192988	.2434
20	7.76	4154	.686	.688	1105.8	14219.76	4231.93	0.00	9987.83	202975	.2562
21	6.65	3675	.713	.730	961.4	12884.53	3730.08	0.00	9154.45	212130	.2673
22	7.25	4255	.710	.740	947.1	15008.44	4084.22	0.00	10924.22	223054	.2821
23	7.33	3941	.698	.715	1062.4	13856.10	4022.31	0.00	9833.79	232888	.2937
24	7.25	3597	.678	.675	1060.2	12565.62	3975.42	0.00	8590.20	241478	.3052
25	7.43	4363	.719	.732	956.5	15388.10	4181.09	0.00	11207.01	252685	.3193
26	4.76	2488	.642	.671	651.1	8719.39	2894.17	0.00	5825.22	258510	.3268
27	7.09	3740	.684	.703	1031.0	13169.24	3911.23	0.00	9258.01	267768	.3388
28	7.45	3967	.658	.708	1378.7	14315.76	4078.20	0.00	9937.56	278036	.3511
29	7.40	3586	.713	.705	1087.0	13717.15	4038.13	0.00	9679.02	287665	.3633
30	5.25	2941	.683	.588	672.5	10313.77	3180.43	0.00	7133.33	294813	.3726
31	7.23	3835	.672	.634	1014.4	13477.23	4036.79	0.00	9440.44	304253	.3847
32	7.57	4416	.765	.705	1069.1	15512.52	4389.95	0.00	11122.57	315381	.3986
33	7.65	4119	.681	.699	1077.5	14446.98	4213.67	0.00	10233.31	325615	.4116
34	7.05	3546	.640	.655	996.9	12507.64	3934.64	0.00	8573.00	334188	.4227
35	6.73	3734	.677	.702	919.2	13102.98	3839.13	0.00	9263.85	343451	.4345
36	7.82	4404	.713	.724	1070.6	15496.86	4300.21	0.00	11196.66	354648	.4484
37	4.65	2535	.715	.740	673.4	9142.16	2815.75	0.00	6326.42	360974	.4566
38	5.52	3011	.663	.704	762.6	10672.28	3238.52	0.00	7433.76	368408	.4661
39	7.37	4365	.663	.713	1019.2	14469.22	4085.28	0.00	10383.94	378792	.4793
40	7.27	3715	.663	.674	1036.7	13192.36	4007.03	0.00	9185.04	387977	.4906
41	7.27	3533	.650	.677	1124.9	12508.44	3926.32	0.00	8582.12	396559	.5017
42	7.99	3952	.695	.705	1276.3	14349.00	4205.61	0.00	10143.39	406703	.5141
43	7.99	4009	.645	.670	1162.3	14241.14	4313.81	0.00	9927.34	416630	.5268
44	5.37	2603	.682	.668	821.3	9341.88	3094.70	0.00	6247.18	422877	.5350
45	7.21	3597	.681	.695	1293.6	13218.94	4080.61	0.00	9138.33	432016	.5466
46	5.33	2654	.674	.661	827.6	9554.40	3098.77	0.00	6455.63	438471	.5550
47	3.47	1716	.583	.603	578.4	6050.49	2438.48	0.00	3612.01	442083	.5604
48	6.83	3181	.704	.698	1160.0	11670.96	3631.01	0.00	8039.96	450123	.5704
49	4.15	2090	.630	.667	597.1	7407.44	2586.63	0.00	4821.01	454944	.5772
50	5.04	2330	.625	.646	782.4	8279.62	2933.38	0.00	5346.24	460290	.5843
51	5.67	2835	.693	.694	874.3	10100.30	3219.74	0.00	6880.56	467171	.5933
52	7.02	3301	.672	.668	1115.7	11702.72	3784.13	0.00	7918.58	475089	.6037
53	5.76	2474	.656	.651	993.8	8843.49	3160.53	0.00	5687.96	480777	.6114
54	5.71	2446	.624	.628	946.7	8849.71	3175.57	0.00	5674.15	486451	.6191
55	4.48	2171	.638	.635	667.2	7658.11	2813.67	0.00	4844.45	491296	.6263

TABLE 6.3 (CONTINUED)

56	4.31	1693	.622	.566	701.4	6887.91	2699.48	0.00	4188.43	495484	.6319
57	3.72	1557	.611	.585	580.4	5687.14	2348.96	0.00	3338.18	498322	.6369
58	4.92	2388	.661	.579	798.3	6508.18	2943.61	0.00	5564.57	504387	.6444
59	5.03	2170	.593	.601	869.1	7903.62	3022.16	0.00	4901.46	509288	.6512
60	4.13	1597	.614	.544	646.9	6893.27	2528.07	0.00	4365.20	513654	.6573
61	4.05	1740	.501	.509	780.9	6347.82	2841.59	0.00	3506.23	517160	.6627
62	3.30	1315	.562	.597	567.3	4758.37	2113.39	0.00	2644.98	519805	.6668
63	4.70	1985	.611	.598	775.2	7199.12	2792.49	0.00	4406.53	524211	.6730
64	4.34	1540	.539	.559	780.2	5629.56	2523.19	0.00	3106.37	527318	.6779
65	4.59	1735	.535	.553	757.3	6266.02	2690.09	0.00	3575.93	530894	.6833
66	3.95	1870	.610	.515	550.3	6555.82	2511.21	0.00	4044.61	534938	.6892
67	3.45	1309	.518	.522	523.5	4740.60	2266.87	0.00	2473.73	537412	.6935
68	3.63	1393	.531	.526	546.7	4918.68	2327.24	0.00	2591.43	540003	.6979
69	3.47	1408	.524	.559	653.7	5357.55	2623.33	0.00	2734.23	542738	.7025
70	2.59	1030	.460	.516	427.7	3632.94	2023.37	0.00	1609.57	544347	.7058
71	2.65	1397	.529	.558	548.9	3898.46	2056.11	0.00	1842.35	546190	.7092
72	3.52	1625	.672	.559	558.1	5890.68	2243.70	0.00	3646.98	549837	.7144
73	4.49	1369	.400	.424	794.7	4854.70	2895.89	0.00	1958.81	551795	.7187
74	3.24	1234	.453	.500	593.1	4349.44	2447.95	0.00	1901.49	553697	.7226
75	2.72	1287	.561	.545	507.9	4555.82	2120.54	0.00	2436.23	556133	.7266
76	2.37	1034	.497	.544	528.0	3625.50	2211.42	0.00	1415.08	557548	.7299
77	3.21	1111	.493	.408	510.5	3940.82	2213.07	0.00	1727.76	559276	.7334
78	2.75	1132	.513	.542	569.7	4047.50	2354.92	0.00	1692.58	560968	.7369
79	3.65	1304	.465	.463	700.8	4594.94	2880.77	0.00	1714.17	562683	.7411
80	3.33	1236	.573	.540	595.7	4446.01	2222.55	0.00	2224.16	564907	.7449
81	3.22	1222	.463	.514	712.1	4319.28	2615.52	0.00	1703.77	566610	.7485
82	3.41	1121	.467	.454	719.5	4023.94	2620.29	0.00	1403.65	568014	.7523
83	2.74	1107	.454	.530	718.3	3946.35	2619.52	0.00	1326.84	569341	.7558
84	2.47	856	.507	.474	506.4	3026.34	2074.13	0.00	952.21	570293	.7585
85	3.31	926	.473	.425	735.4	3495.94	2448.85	0.00	1046.09	571341	.7614
86	2.99	822	.405	.393	614.6	3025.15	2280.16	0.00	744.98	572086	.7643
87	3.01	841	.423	.369	597.6	3002.06	2405.43	0.00	596.62	572683	.7666
88	3.49	967	.355	.392	651.9	3451.28	2440.49	0.00	1010.79	573694	.7697
89	2.25	792	.504	.495	577.5	2827.39	2074.55	0.00	752.84	574447	.7721
90	4.21	1355	.414	.429	890.2	5026.37	3229.95	0.00	1796.41	576243	.7764
91	4.09	1349	.411	.444	868.4	4855.52	3079.69	0.00	1775.84	578019	.7807
92	2.77	694	.374	.343	493.6	2537.61	2065.99	0.00	471.62	578490	.7829
93	3.14	915	.423	.419	604.9	3291.18	2273.92	0.00	1016.26	579507	.7857
94	2.17	730	.404	.492	417.5	2571.52	1880.56	0.00	690.96	580198	.7880
95	3.79	997	.376	.362	644.0	3583.73	2520.18	0.00	1062.55	581260	.7912
96	3.20	683	.343	.268	537.8	2478.87	2276.34	0.00	202.53	581463	.7933
97	3.41	860	.335	.323	532.6	3111.30	2466.99	0.00	610.31	582073	.7960
98	3.93	1055	.355	.370	796.9	3794.85	2853.20	0.00	941.66	583015	.7994
99	2.45	630	.318	.349	499.2	2211.53	2065.51	0.00	147.02	583162	.8013
100	2.21	703	.404	.436	405.4	2472.24	1956.87	0.00	516.36	583680	.8036
101	2.73	633	.335	.302	502.3	2151.91	2116.89	0.00	35.02	583725	.8055
102	3.70	723	.251	.262	675.0	2541.61	2037.04	0.00	-93.44	583627	.8077
103	2.74	524	.293	.263	447.6	1879.19	1990.62	0.00	-111.63	583515	.8094
104	2.92	590	.313	.330	587.2	2461.20	2262.47	0.00	198.72	583714	.8116
105	3.95	623	.236	.219	641.1	2271.97	2524.32	0.00	-253.35	583461	.8135
106	3.48	800	.332	.301	655.2	2821.21	2624.24	0.00	196.97	583658	.8163
107	2.64	440	.227	.221	454.7	1621.33	1949.99	0.00	-328.66	583329	.8174
108	2.51	500	.256	.239	447.7	1764.40	2030.30	0.00	-266.90	583062	.8190
109	2.33	418	.265	.232	376.9	1471.88	1899.83	0.00	-425.95	582636	.8203
110	4.57	775	.257	.247	916.3	2651.12	3013.67	0.00	-160.55	582475	.8229
111	2.17	426	.301	.264	380.2	1506.03	1814.99	0.00	-308.95	582161	.8241
112	1.57	412	.309	.361	370.9	1482.32	1668.84	0.00	-186.52	581974	.8254

TABLE 6.3 (CONTINUED)

113	2.23	407	.371	.289	442.5	1725.19	1896.68	0.00	-171.49	581633	.8269
114	3.55	558	.272	.238	638.3	2133.39	2386.28	0.00	-252.39	581550	.8267
115	2.96	583	.321	.337	624.1	2237.62	2150.02	0.00	57.60	581608	.8336
116	2.28	462	.332	.304	487.4	1736.05	1880.19	0.00	-94.13	581514	.8320
117	2.57	609	.374	.320	692.4	2335.61	2330.32	0.00	-24.72	581489	.8339
118	1.22	385	.626	.537	357.3	1571.06	1478.42	0.00	92.64	581532	.8352
119	1.24	493	.758	.545	396.3	2005.02	1548.97	0.00	456.05	582038	.8367
120	.83	382	.689	.570	268.7	1349.75	1330.42	0.00	18.62	582056	.8379
121	2.53	511	.222	.269	432.1	1815.31	1980.81	0.00	-165.51	581691	.8395

TABLE 6.3 (CONCLUDED)

DAILY SUMMARY

Mean utilization, hours	4.94
Standard deviation of utilization, hours	2.20
Load factor	.60
Total passengers carried	266,555.
Total direct operating cost, dollars	366,555.
Total indirect operating cost, dollars	97,405.
Total revenue, dollars	948,445.
Total profit, dollars	484,486.
Mean passenger wait time, min.	14.08
Total demand	317,513.
Percent demand carried	83.95
Total revenue flights	4,627.
Total distance flown, miles	96,274.
Total revenue passenger miles flown	5,090,832.
Number ferry flights	204.
Total distance ferried, miles	6,739.
Profit per passenger, dollars	1.82
Fleet size	121
Total gates required	71

TABLE 6.4
NETWORK MODEL RESULTS
153 SEAT AUGMENTOR WING STOL

FLIGHT STATISTICS

FLT NBR	HRS UTIL	PAX	WGT L.F.	L.F.	DISTANCE	REVENUE	DOC	IOC	PROFIT	CUM PRO	C.PCNT
1	6.96	5009	.564	.574	953.6	17539.15	5152.80	0.00	12386.35	12386	.0158
2	4.99	3499	.556	.558	677.8	12310.27	3947.69	0.00	8362.58	20749	.0268
3	5.25	3643	.583	.567	745.2	12922.43	4063.97	0.00	8858.46	29607	.0383
4	5.05	3312	.521	.528	703.2	11593.21	3968.40	0.00	7624.81	37232	.0467
5	7.29	5194	.544	.548	930.8	18191.28	5440.43	0.00	12750.85	49983	.0651
6	6.76	5141	.572	.579	851.4	18038.08	5130.59	0.00	12907.49	62891	.0812
7	5.59	3656	.575	.569	872.3	13035.07	4167.84	0.00	8867.24	71758	.0928
8	6.46	4311	.547	.542	910.9	15140.60	4811.76	0.00	10328.84	82087	.1063
9	5.52	3434	.498	.510	791.6	12147.35	4224.31	0.00	7923.03	90010	.1172
10	4.93	3084	.507	.517	714.2	10896.30	3854.89	0.00	7042.01	97052	.1265
11	6.27	4351	.573	.569	897.2	15445.78	4678.08	0.00	10767.70	107839	.1406
12	5.82	4089	.557	.557	767.9	14350.02	4466.30	0.00	9893.72	117733	.1535
13	5.07	3300	.539	.553	766.2	11733.61	3897.40	0.00	7836.21	125569	.1638
14	4.94	3413	.553	.558	689.3	11965.87	3895.81	0.00	8070.06	133639	.1746
15	5.46	3242	.538	.558	792.3	11622.25	3857.50	0.00	7764.75	141404	.1848
16	5.79	3526	.553	.549	947.9	12756.04	4229.57	0.00	8526.47	149931	.1959
17	6.04	3761	.516	.515	867.5	13371.79	4531.33	0.00	8840.47	158771	.2078
18	4.55	2926	.540	.531	657.3	10345.56	3624.68	0.00	6720.88	165492	.2170
19	5.64	3716	.571	.565	862.5	13167.58	4221.05	0.00	8946.54	174438	.2287
20	5.53	3832	.545	.557	765.6	13534.65	4264.37	0.00	9270.27	183709	.2408
21	5.83	3844	.573	.584	846.9	13586.86	4208.30	0.00	9378.58	193087	.2529
22	4.44	2938	.502	.519	588.4	10237.82	3629.65	0.00	6658.17	199745	.2622
23	4.96	3202	.529	.537	725.1	11259.91	3863.78	0.00	7396.13	207142	.2722
24	5.23	3439	.527	.535	741.0	12183.69	4060.54	0.00	8123.15	215265	.2831
25	4.78	3080	.548	.575	770.5	11059.55	3655.92	0.00	7403.63	222668	.2928
26	5.44	3617	.535	.550	787.1	12721.20	4159.44	0.00	8561.76	231230	.3042
27	5.19	3362	.562	.563	808.7	11941.76	3932.12	0.00	8009.64	239240	.3148
28	5.77	4193	.545	.583	795.4	14715.32	4411.21	0.00	10304.12	249544	.3280
29	4.93	3272	.506	.522	657.4	11517.76	3930.97	0.00	7586.78	257131	.3383
30	4.84	3082	.499	.517	680.6	10850.06	3827.49	0.00	7022.58	264153	.3480
31	5.13	3195	.500	.509	731.0	11356.15	3991.08	0.00	7365.06	271518	.3580
32	4.36	2635	.525	.507	644.2	9324.11	3491.55	0.00	5832.55	277351	.3663
33	5.79	3281	.455	.476	862.3	11747.34	4343.33	0.00	7404.01	284755	.3767
34	5.02	3307	.516	.540	719.7	11682.27	3920.69	0.00	7761.58	292516	.3871
35	5.44	3075	.491	.479	818.4	11030.83	4123.79	0.00	6907.04	299424	.3968
36	5.04	3000	.501	.503	754.7	10749.21	3888.02	0.00	6861.19	306285	.4062
37	4.54	2758	.495	.501	656.6	9714.40	3624.09	0.00	6090.31	312375	.4149
38	4.47	2726	.534	.540	713.3	9793.42	3466.70	0.00	6306.71	318682	.4235
39	5.42	3281	.473	.496	782.1	11492.51	4155.37	0.00	7337.14	326019	.4336
40	7.76	3597	.435	.425	1163.8	13807.53	5508.29	0.00	8299.25	334318	.4460
41	3.53	2026	.469	.473	509.0	7097.37	3013.61	0.00	4083.76	338402	.4524
42	5.61	2871	.466	.447	878.7	10382.30	4173.02	0.00	6209.28	344611	.4615
43	5.40	3245	.521	.505	803.1	11552.39	4111.29	0.00	7441.10	352052	.4717
44	3.96	1858	.452	.443	667.7	6898.41	3143.30	0.00	3755.11	355807	.4777
45	6.24	3134	.415	.418	913.8	11036.46	4630.40	0.00	6406.06	362213	.4875
46	4.22	2195	.451	.478	633.8	7795.66	3238.10	0.00	4561.56	366775	.4944
47	4.97	2573	.421	.443	758.3	9088.57	3829.68	0.00	5258.89	372034	.5025
48	6.14	2870	.374	.391	904.9	10173.45	4561.88	0.00	5611.56	377645	.5116
49	3.27	1667	.380	.419	468.9	5934.90	2858.41	0.00	3076.49	380722	.5168
50	3.07	1730	.426	.452	423.6	6083.25	2760.12	0.00	3323.13	384045	.5223
51	4.38	2107	.451	.444	737.1	7590.80	3383.74	0.00	4207.07	388252	.5289
52	3.52	1870	.483	.472	562.4	6834.82	2934.73	0.00	3900.09	392152	.5348
53	5.62	2357	.348	.371	918.8	8569.17	4267.02	0.00	4302.15	396454	.5423
54	3.55	1520	.415	.440	546.1	6451.89	2982.69	0.00	3469.20	399924	.5481
55	1.80	760	.413	.414	356.3	2830.64	1970.27	0.00	860.38	400784	.5505

TABLE 6.4 (CONTINUED)

56	5.21	2579	.445	.421	787.5	9192.61	3976.07	0.00	5216.54	406000	.5586
57	3.65	1716	.373	.400	585.6	6196.09	3137.64	0.00	3092.45	409055	.5640
58	4.12	1997	.399	.408	645.0	7014.25	3430.93	0.00	3583.32	412636	.5703
59	3.26	1811	.429	.455	533.0	6381.33	3033.23	0.00	3348.39	415984	.5760
60	4.93	1981	.348	.360	864.8	7171.75	3916.71	0.00	3255.04	419239	.5822
61	5.58	2293	.349	.341	878.0	8176.52	4417.41	0.00	3759.11	422998	.5895
62	4.45	2086	.373	.379	623.6	7333.37	3597.20	0.00	3736.17	426735	.5960
63	5.97	3059	.406	.435	1032.5	10359.19	4788.59	0.00	6070.60	432805	.6057
64	4.80	2170	.387	.383	756.9	7716.69	3828.52	0.00	3868.17	436693	.6125
65	4.80	1786	.321	.324	785.8	6427.86	3790.94	0.00	2636.94	439330	.6191
66	5.51	2411	.371	.375	876.1	8566.36	4232.12	0.00	4334.24	443665	.6257
67	4.97	2257	.402	.399	818.2	8170.37	3878.60	0.00	4191.47	447856	.6328
68	4.42	2007	.339	.356	846.9	7159.12	3799.93	0.00	3259.19	451115	.6391
69	4.20	1953	.388	.399	710.5	6947.41	3545.72	0.00	3401.69	454517	.6453
70	6.02	2223	.331	.330	974.1	7979.54	4373.44	0.00	3606.10	458123	.6523
71	4.71	2095	.373	.360	762.3	7433.08	4016.72	0.00	3416.35	461539	.6589
72	4.39	1520	.285	.310	714.1	5534.86	3426.14	0.00	2108.72	463648	.6637
73	4.21	1640	.408	.382	773.1	6736.23	3596.87	0.00	3139.36	466787	.6695
74	4.44	1711	.360	.329	775.8	6152.99	3782.73	0.00	2370.26	469156	.6749
75	5.04	2477	.358	.352	959.3	8821.66	4545.11	0.00	4276.54	473434	.6827
76	3.97	2052	.400	.419	590.5	7194.19	3651.85	0.00	3542.34	476977	.6891
77	3.01	1341	.339	.365	563.3	4730.24	3057.99	0.00	1673.25	478655	.6933
78	2.01	770	.242	.363	377.2	2347.77	2109.83	0.00	737.94	479393	.6918
79	2.97	1318	.329	.343	603.0	4174.33	2843.86	0.00	1330.48	480723	.6953
80	3.76	1725	.367	.309	699.1	6086.64	3475.14	0.00	2611.50	483335	.7047
81	3.97	1455	.305	.337	653.5	5168.27	3437.90	0.00	1730.37	485065	.7093
82	4.65	2170	.334	.405	837.6	7786.14	3894.48	0.00	3891.66	488957	.7162
83	3.82	1395	.312	.334	622.6	4937.52	3228.92	0.00	1708.60	490665	.7205
84	5.40	1806	.265	.281	804.0	6404.25	4112.01	0.00	2292.24	492956	.7262
85	3.58	1284	.295	.300	592.9	4559.46	3204.65	0.00	1354.81	494312	.7303
86	3.87	1352	.303	.305	641.0	4839.53	3243.93	0.00	1595.60	495908	.7345
87	4.71	1585	.299	.305	842.5	5912.99	3775.99	0.00	2137.00	498045	.7395
88	5.10	1570	.266	.263	775.7	5660.82	3905.14	0.00	1755.68	499801	.7445
89	3.81	990	.252	.240	641.7	3729.27	3060.76	0.00	668.51	500469	.7476
90	3.22	992	.311	.270	574.2	3562.25	2944.43	0.00	617.83	501087	.7507
91	3.65	1186	.292	.287	648.2	4230.36	3188.56	0.00	1041.81	502129	.7544
92	3.47	1248	.320	.326	605.4	4468.93	2969.93	0.00	1499.00	503628	.7584
93	3.83	1015	.251	.246	714.8	3774.42	3243.02	0.00	531.40	504159	.7616
94	4.19	1163	.244	.253	727.9	4133.36	3376.17	0.00	756.89	504916	.7652
95	2.48	765	.251	.257	385.0	2771.86	2483.61	0.00	288.25	505204	.7677
96	3.75	1010	.228	.236	622.1	3545.86	3167.26	0.00	378.59	505583	.7709
97	2.80	795	.275	.260	391.3	2804.41	2427.52	0.00	376.89	505960	.7734
98	4.64	1232	.235	.230	722.2	4429.01	3616.51	0.00	812.50	506772	.7772
99	4.35	1262	.251	.266	650.6	4469.35	3374.27	0.00	1095.08	507867	.7813
100	2.76	703	.213	.230	451.6	2540.99	2476.85	0.00	64.14	507931	.7835
101	2.54	644	.213	.222	432.3	2292.33	2461.01	0.00	-168.68	507763	.7855
102	2.19	695	.317	.284	419.7	2512.24	2328.24	0.00	184.00	507947	.7877
103	2.63	723	.225	.249	530.3	2599.74	2663.55	0.00	-63.82	507883	.7900
104	3.50	850	.236	.222	617.1	3165.11	2979.44	0.00	185.66	508069	.7926
105	3.97	925	.217	.216	670.5	3505.33	3145.54	0.00	359.79	508423	.7956
106	2.18	696	.300	.284	485.6	2516.19	2504.55	0.00	11.64	508440	.7977
107	2.72	637	.189	.198	475.5	2252.35	2680.04	0.00	-427.69	508012	.7997
108	1.05	637	.640	.595	322.4	2503.77	1820.05	0.00	783.71	508796	.8018

TABLE 6.4 (CONCLUDED)

DAILY SUMMARY

Mean utilization, hours	4.56
Standard deviation of utilization, hours	1.22
Load factor	.426
Total passengers carried	254,568.
Total direct operating cost, dollars	396,467.
Total indirect operating cost, dollars	93,126.
Total revenue, dollars	905,263.
Total profit, dollars	415,670.
Mean passenger wait time, min.	14.25
Total demand	317,513.
Percent demand carried	80.18
Total revenue flights	3,805.
Total distance flown, miles	76,807.
Total revenue passenger miles flown	4,838,802.
Number ferry flights	87.
Total distance ferried, miles	2,591.
Profit per passenger, dollars	1.63
Fleet Size	108.
Total gates required	61.

funds are below the line, all on a daily basis. The DOC and IOC as shown do not include depreciation on aircraft or facilities. The sinking fund refers to an interest earning, capital account for replacement of aircraft (after 10 years), and terminals (after 20 years). For a more detailed explanation of these terms, see Reference 1.

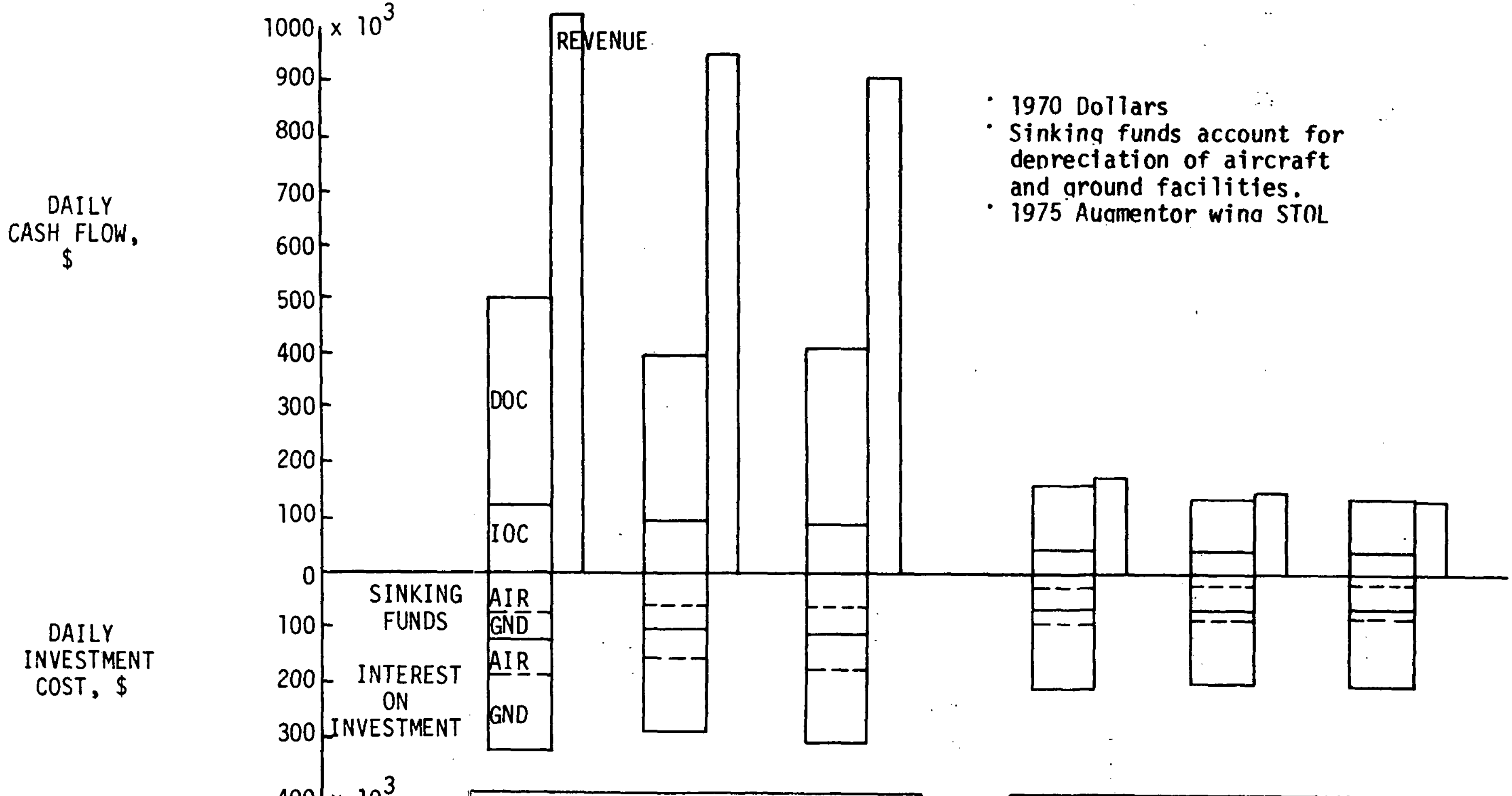
The impact of this chart is quite dramatic, and shows, primarily, the economic benefit of larger scale operations. The total investment costs have only increased 24%, while the daily cash flows have increased by factors of 2 to 5. The investment cost increase is due to the increased number of aircraft, gates, and maintenance facilities required. There are no additional terminals (STOLPORTS) required. Each existing terminal is utilized more efficiently. This efficiency is also evident in the DOC and IOC which increase at a rate much less than the increase in traffic. The DOC's are improved by increasing the average load factor from 45% to 60%. The 95 and 153 seat aircraft can carry the heavy new demand without any increase in the number of runways needed. For the 49 seat aircraft, however, a second runway would be required in downtown San Francisco. This cost was not included in Figure 6.11.

All of these factors allow the new systems to show a substantial profit for all three airplane sizes. The previous study results showed substantial losses for each aircraft size.

Table 6.5 compares a number of additional system characteristics for the best airplane of the current system (the 95 seat STOL) with those characteristics for the base case of Reference 1. Again, the economic benefits from the increased scale of operations for the new system shows a 60% reduction in the total cost of carrying one passenger one mile.

Since the demand model is relatively insensitive to cost, one could argue that it overpredicts demand at the base fare level. However, even if one assumes that the base demand is available at 70% of the base fare, the 95 seat aircraft just about breaks even. This amounts to a cost of $5.00 ($2.50 each way) per day for commuting to work. Even this reasonable cost could be reduced by assuming some federal subsidy and concession income as suggested in the cash flow analysis in Section 11.5 of Reference 1.

The impact of these analyses on the major conclusion of Reference 1 is to suggest that the system can not only be technically feasible and socially viable, but now it might be economically feasible without subsidy. This study is not sufficient justification for building an aircraft for this market, but it does provide justification for continued effort in this area.



	DEMAND MODEL PREDICTION			INTRAURBAN STUDY		
AIRCRAFT SIZE (SEATS)	49	95	153	49	95	153
PASSENGERS CARRIED DAILY	287,404	266,555	254,568	48,551	40,830	36,052
NET PROFIT (LOSS) PER DAY	$203,220	$271,900	$195,800	($194,000)	($190,000)	($208,000)
NET PROFIT (LOSS) PER PASS	$ .71	$1.02	$ .77	($4.05)	($4.70)	($5.80)

FIGURE 6.11: ECONOMIC COMPARISON (1980)

TABLE 6.5 AIRCRAFT SYSTEM CHARACTERISTICS COMPARISON (1980)

System Characteristics	Demand Model Prediction 95 Seat STOL	Intraurban Base Case 49 Seat STOL
Daily Passenger Demand	317,513	60,105
Daily Passengers Carried	266,555	48,551
Daily RPM's	5,090,832	1,135,690
Daily Revenue Flights	4,627	2,190
Daily Ferry Flights	204	102
Average Load Factor	0.60	0.447
Average Passenger Trip Distance (Miles)	19.1	23.4
Aircraft Required	121	73
Aircraft Utilization (Hours/Day)	4.94	4.22
Number of Gates	71	48
Number of Terminals	23	24
Number of Links	113	65
Daily DOC (No Depreciation)	$296,600	$114,250
Daily IOC	97,405	47,586
Total Initial Investment	925,300,000	745,000,000
Daily Investment Cost	176,800	139,000
Daily Sinking Fund Cost	105,700	70,100
Daily Revenue	948,445	174,890
Total Daily Profit (Loss)	271,900	(196,000)
Profit (Loss) Per Passenger	1.02	(4.05)
Average Fare	3.55	3.60
Total Cost Per Passenger	2.53	7.65
Total Cost Per Passenger Mile	0.13	0.33

7.0 APPLICATION OF MODEL AND VALIDATION

7.1 USE OF MODEL

The basic assumption made in applying the generalized demand model and mode split to a new region is that the model coefficients and preference rating data remains the same in the new region (see Section 4.6). Without this basic assumption, it would be necessary to re-evaluate all the terms in the demand model.

The region under study has to be subdivided into a set of zones. It is possible that the region may have been studied previously and subdivided into a set of analysis zones. If this is the case, it may be necessary to regroup these analysis zones into large zones, as was done in the investigation of the San Francisco Bay Area. In this particular case, data existed at the 291 zone level and was regrouped into 30 superzones. In regrouping the zones, an effort was made to eliminate "linear" population areas, so that each zone would have a population centroid about which the population would be evenly distributed.

Once the zone boundaries are established, the demographic variables of population, employment and number of automobiles are gathered. If the area has been analyzed previously, this data will be readily available. Otherwise, census data can be utilized.

The travel is assumed to be between zone centroids, and road distances should be estimated based on this premise. It is generally inaccurate to use straight line centroid-to-centroid distances multiplied by a correction factor, since the factor is itself a function of distance. The time-distance and cost-distance relationships, including bridge penalties, determined in this study can be used to estimate zone-to-zone time and cost data.

The compiled data set can then be input in the generalized demand model and travel data by mode can be generated. An example of the application of this model to the Detroit area is illustrated in Section 7.2.

7.2 DETROIT APPLICATION

To test the general applicability of the model, it was applied to the Detroit region in the 1965 time period. The demographic data and superzone boundaries were taken from Reference 7, a land use study of the Detroit area and two reels of magnetic tape from the Southeast Michigan Council of Governments. The zones as used in Reference 7 are shown in Figure 7.1. The large number of zones (53) necessitated a process of combination and elimination of zones. Figure 7.2 shows the zones as used in this application. The size of each zone is not yet ideal, but is workable. Ideally each zone would consist of just that area that could be considered the capture area for one STOLport.

In addition to the zone description and demographic variables, a matrix of highway distances between zones was developed, Table 7.1. This data was then input to the demand model with an air mode added. Figure 7.3 shows the summary of trips versus range in four mile increments. Note again that the model predicts as much STOL traffic at 40 miles as auto traffic.

It should also be pointed out that the model assumes a steady state condition, many years after the introduction of a new mode, so that travel patterns have had a chance to change considerably. For instance, the model predicts that with the air mode available, the job opportunity area for each individual trip maker has expanded greatly due to the very much reduced trip time at long distances. Over a period of time, people would shift their employment and/or residence to take advantage of this increased flexibility. The result is a longer average trip distance. The STOL is most competitive at the longer ranges, so most of the shift to longer ranges is also a shift to the STOL mode.

The STOL demand shown in Figure 7.3 was run through the network model using the STOL aircraft designed for the intraurban study, Figure 6.8. Additional sizes of 40, 60 and 80 passenger capacity were developed by interpolation of their characteristics shown in Section 6.3.1. The system inputs to the model were unchanged from those shown in Section 6.2.1.

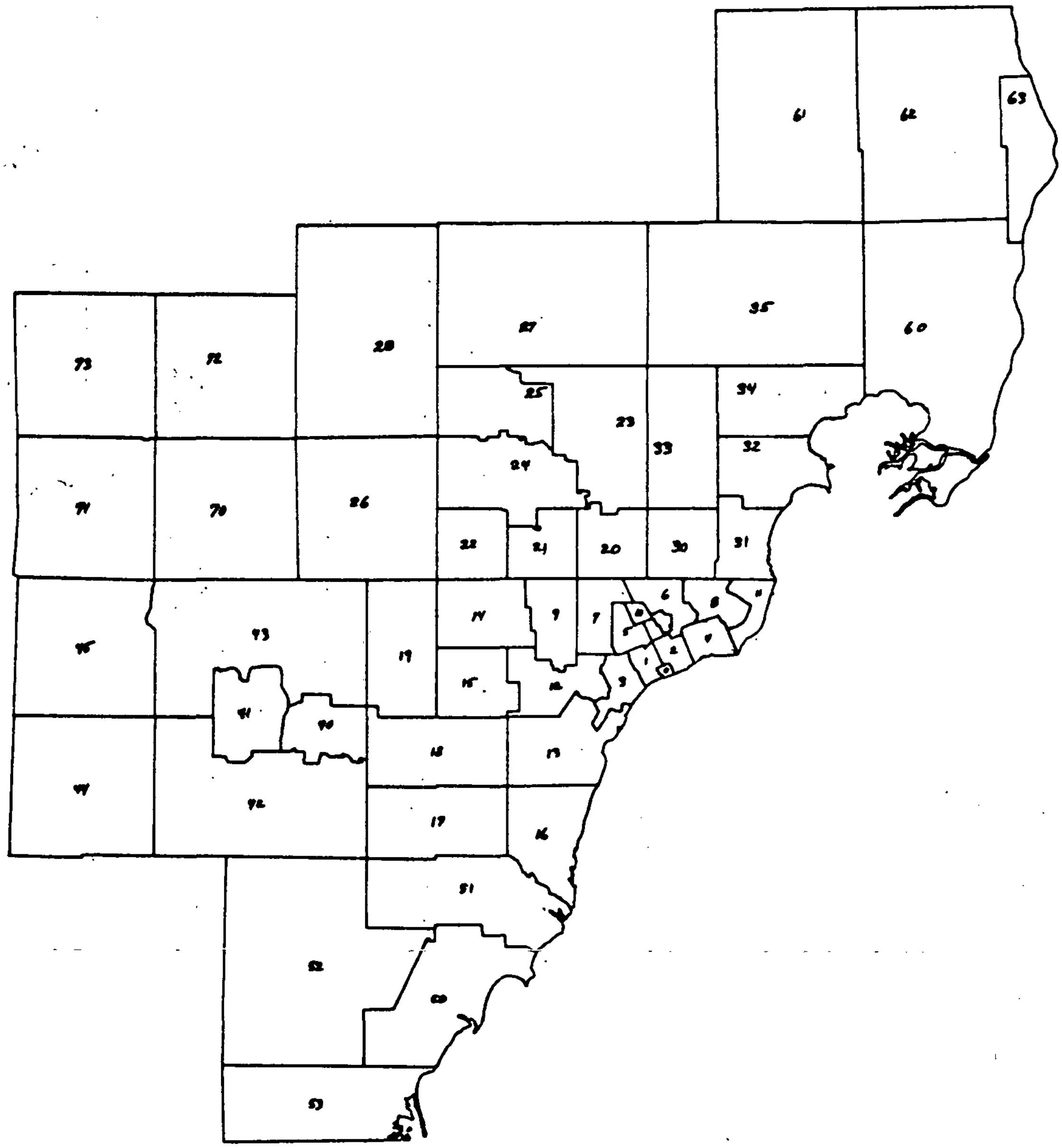


FIGURE 7.1
STANDARD DETROIT TALUS ZONES

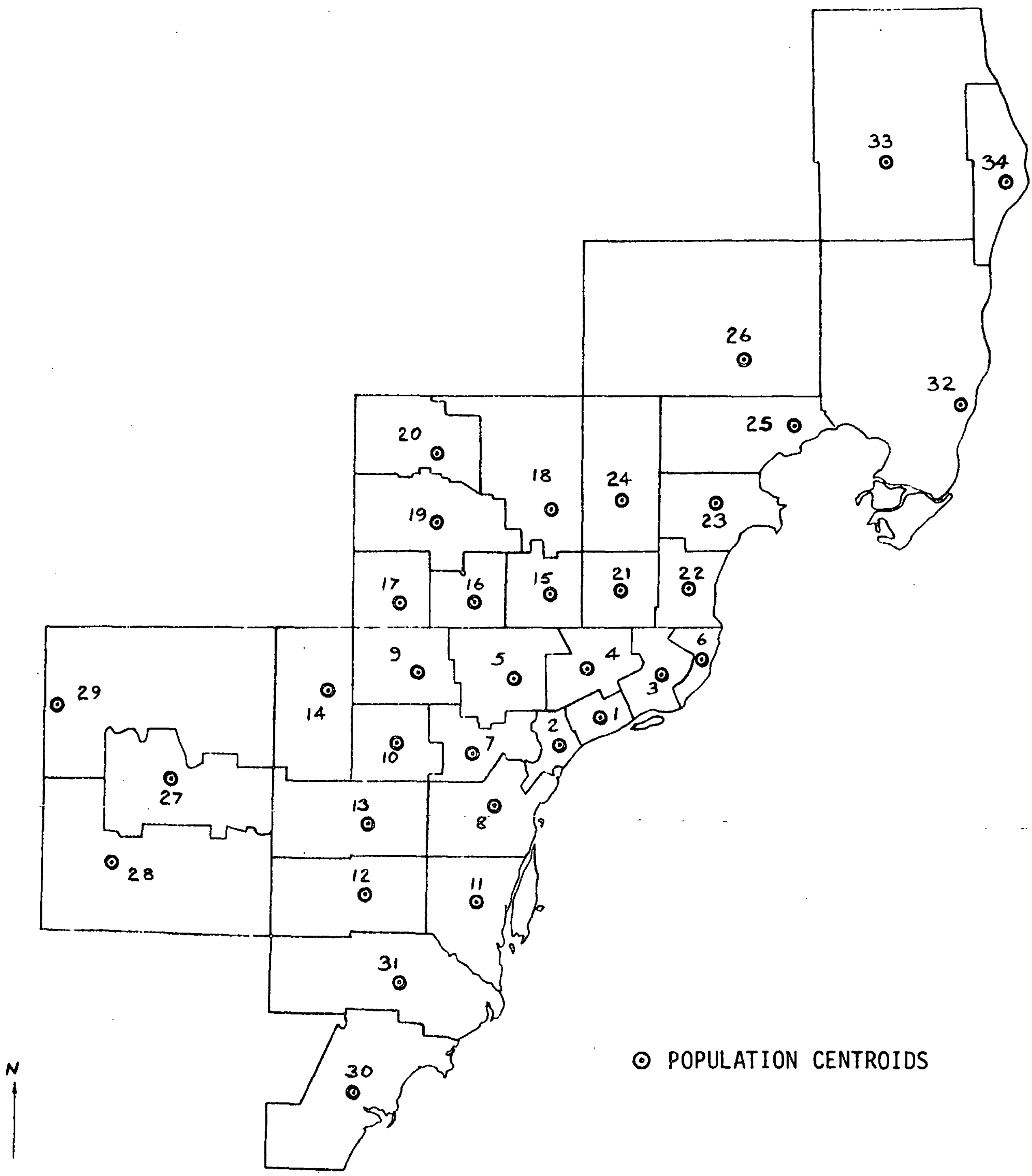


FIGURE 7.2: NEW DETROIT ZONES

TABLE 7.1
HIGHWAY DISTANCES BETWEEN DETROIT SUPERZONE CENTROIDS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1		4.6	7.1	4.3	8.6	11.3	15.1	11.7	16.0	23.2	19.9	27.6	22.0	24.6	11.8	15.6	19.1	19.5	22.6	27.3	13.0	13.3	23.6	20.3	31.2	36.4	39.3	42.7	48.6	36.7	28.8	52.3	62.3	56.9
2			10.9	8.1	9.3	15.1	11.9	8.5	16.7	20.3	16.7	24.7	19.1	25.3	16.5	20.6	19.8	23.8	25.2	29.9	16.8	19.1	27.4	24.1	35.0	40.2	36.4	39.8	49.2	33.5	25.6	56.1	66.1	60.7
3				7.8	13.4	4.0	19.6	18.6	20.8	28.0	27.6	32.4	26.8	29.4	15.3	20.3	25.3	23.2	26.5	31.9	9.3	8.2	16.5	16.6	24.1	29.3	44.1	47.5	53.4	40.6	35.9	45.2	55.2	49.8
4					8.0	12.0	15.8	15.8	15.4	25.2	24.8	29.6	24.0	24.0	8.1	13.1	18.5	15.4	20.4	25.8	9.3	14.4	24.3	16.6	31.9	36.7	39.8	44.7	48.0	41.0	33.1	53.0	63.0	57.6
5						17.6	8.2	17.0	7.4	15.2	26.0	27.6	22.0	16.0	10.7	12.3	11.5	20.6	16.9	21.6	14.9	20.0	29.9	22.2	37.5	42.3	31.8	39.9	40.0	40.0	32.1	58.6	68.6	63.2
6							23.8	22.8	25.0	32.2	31.2	36.6	31.0	33.6	19.3	24.5	29.5	26.8	30.7	35.5	12.9	7.2	15.5	19.6	23.1	28.3	48.3	51.7	57.6	44.8	40.1	44.2	54.2	48.8
7								5.6	10.9	7.6	15.0	19.4	13.8	18.5	18.9	16.3	16.6	28.8	20.2	24.9	23.1	27.8	36.1	30.4	43.7	50.5	31.1	34.5	44.1	31.8	23.9	64.8	74.8	69.4
8									16.5	14.0	9.4	19.8	12.8	24.1	24.5	21.9	22.2	34.4	21.2	25.9	25.1	26.8	35.1	32.4	42.7	47.9	30.1	33.5	42.9	26.2	18.3	63.8	73.8	68.4
9										6.3	25.9	20.9	15.3	9.2	17.8	11.2	7.3	27.7	15.9	20.6	22.3	27.4	39.3	29.6	44.5	49.9	25.0	33.1	33.2	38.9	30.1	66.0	76.0	70.6
10											23.8	14.6	9.0	10.9	23.5	17.5	13.0	33.4	21.6	26.3	28.0	33.1	44.7	35.3	50.2	55.6	26.3	29.7	34.9	32.6	23.8	73.2	83.2	77.8
11												13.4	14.8	27.6	33.2	31.3	31.6	40.5	35.2	39.9	33.5	36.2	44.1	40.8	51.7	56.9	32.9	32.9	45.7	19.8	11.9	72.8	82.8	77.4
12													5.6	18.4	38.1	32.1	27.6	48.6	35.4	40.1	44.3	40.6	59.3	51.6	56.5	61.7	23.7	22.1	36.5	18.0	9.2	77.6	87.6	82.2
13														12.8	32.5	26.5	22.0	43.0	29.8	34.5	38.7	35.0	53.7	46.0	50.9	56.1	18.1	21.5	30.9	23.6	14.8	72.0	82.0	76.6
14															26.4	19.8	15.9	32.1	24.7	29.2	33.3	36.0	47.9	40.6	55.5	60.9	17.4	25.5	25.6	36.4	27.6	74.6	84.6	79.2
15																6.6	13.2	9.9	8.5	19.9	6.9	12.0	21.5	14.2	29.1	34.3	43.0	50.3	51.2	48.5	40.6	50.2	63.5	58.1
16																	6.6	16.5	8.2	13.3	13.5	18.6	28.1	20.8	35.7	40.9	36.4	43.7	44.6	50.1	40.2	56.8	66.8	61.4
17																		23.1	11.2	15.9	20.1	25.2	34.7	27.4	42.3	47.7	32.5	39.8	40.7	45.6	36.8	63.4	73.4	68.0
18																			9.2	10.8	14.3	19.4	18.2	7.0	28.4	27.3	47.9	56.0	56.9	56.2	48.3	43.0	59.5	54.1
19																				5.3	20.8	27.9	27.4	16.2	37.0	36.5	40.5	48.6	49.5	53.4	44.6	62.2	68.7	63.3
20																					24.6	29.7	29.0	17.8	38.6	38.1	53.2	59.0	55.2	58.1	49.3	53.8	70.3	64.9
21																						5.1	14.6	7.3	22.2	27.4	49.1	57.2	56.5	49.7	41.8	43.3	53.3	47.9
22																							9.5	12.4	17.1	22.3	51.8	55.7	61.6	50.0	42.1	38.2	48.2	42.8
23																								11.2	10.2	15.4	63.7	64.0	70.0	60.3	52.4	24.8	41.3	35.9
24																									20.8	20.3	56.4	54.5	64.6	57.0	49.1	35.4	51.9	46.5
25																										6.9	71.3	71.6	77.5	67.9	60.0	16.3	32.8	27.4
26																											76.7	76.8	82.7	73.1	65.2	19.6	36.1	30.7
27																												10.0	16.2	35.5	32.9	89.3	99.3	93.9
28																													14.0	33.6	31.3	92.7	102.7	97.3
29																														46.3	43.6	98.6	108.6	103.2
30																															8.8	85.8	95.8	90.4
31																																81.1	91.1	85.7
32																																	26.4	21.0
33																																		9.4
34																																		

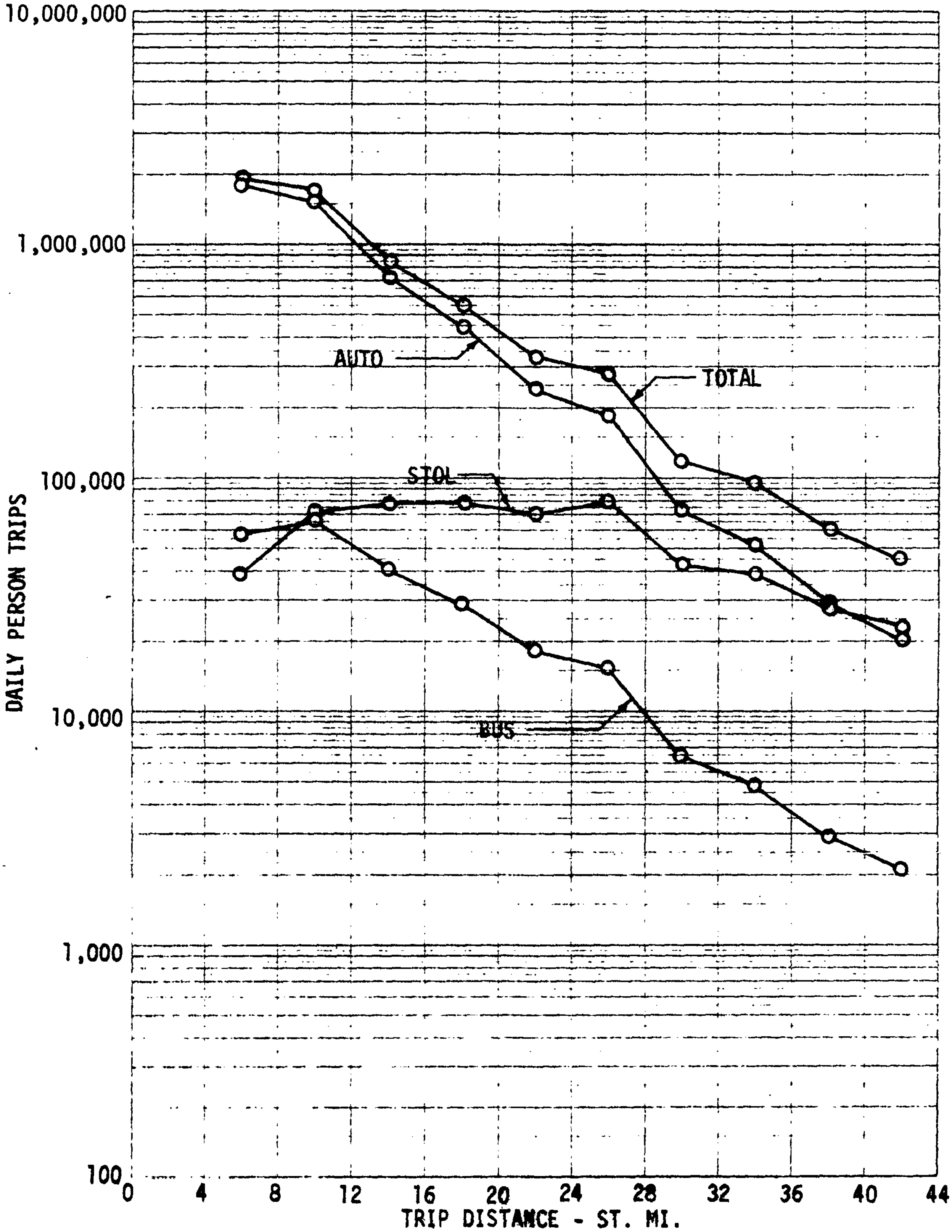


FIGURE 7.3
DEMAND MODEL RESULTS - DETROIT (1965)

To understand the directional peaking in the time of day demand between zones, Table 7.2 was developed. It shows the ratio of employment to population for each zone in the San Francisco and Detroit areas. While the average ratio for each area was the same at 0.37 to 0.38, only one major zone in each area showed more employment than population (zone 29 in Detroit was too small and was dropped). This would indicate high demand into the area in the morning and out in the evening, as was discovered in San Francisco. This peaking is characterized by curves 3 and 2 respectively from Figure 6.9. As in the case of San Francisco, curve 3 was used to describe the time of day distribution of all demand into zone 1; durve 2 was used to describe the demand out of zone 1 to any other zone; and curve 1 was used for all other links.

The segment demands are shown in Table 7.3. There are a total of 238 one-way segments connecting 21 STOLports. These consist of all segments for which 750 one-way passengers per day were predicted. Figure 7.4 shows which STOLports were connected by direct flights.

The summary results from the network model for the 40, 60, 80 and 95 seat aircraft are shown in Tables 7.4 through 7.7, respectively. A more complete economic comparison is shown in Figure 7.5. These results indicate that the 80 passenger aircraft is the best, but clearly, the 60 and 95 seat vehicles are also acceptable. The analysis here is not sufficient to rule out any but the 40 passenger aircraft.

As shown for San Francisco, the scale of operations allows a profitable system to exist. This would only be true, however, after a substantial time were allowed for travel patterns to shift.

The results also show somewhat poorer economics than was shown for San Francisco. This is due partly to lower demand and partly to shorter average trips.

TABLE 7.2 - EMPLOYMENT TO POPULATION RATIOS (1965)		
ZONE	EMPLOYMENT / POPULATION	
	SAN FRANCISCO	DETROIT
1	2.02	1.34
2	.31	.48
3	.81	.20
4	.15	.43
5	.29	.27
6	.35	.21
7	.52	.44
8	.38	.26
9	.37	.29
10	.18	.17
11		.36
12		.07
13	.33	.45
14	.23	.60
15	.24	.29
16	.29	.47
17	.54	.23
18	.43	.29
19	.23	.29
20	.33	.42
21	.20	.50
22	.35	.16
23	.33	.28
24		.44
25	.39	.12
26		.16
27	.27	.50
28	.41	.58
29	.21	1.10
30	.27	.34
31		.33
32		.27
33		.21
34		.31
AVERAGE	.38	.37

TABLE 7.3

1965 DAILY STOL TRAVEL DEMAND - DETROIT

From	To	Distance (miles)	Direct Demand	Return Demand
1	7	10	1834	1781
	8	11	1579	1553
	9	15	1862	1792
	10	16	1473	1412
	11	17	1493	1378
	14	21	1399	1267
	15	10	2033	1986
	16	13	1540	1422
	18	16	1459	1360
	19	19	1468	1372
	20	24	1874	1795
	21	10	2220	2148
	22	12	1707	1645
	23	19	1401	1301
	24	17	1415	1302
	27	33	1518	1457
2	7	7	1035	1038
	9	12	1094	1087
	10	12	887	877
	11	14	867	827
	14	18	831	777
	15	12	1171	1181
	16	13	924	880
	18	18	801	770
	19	19	858	828
	20	24	1008	996
	21	13	1350	1348
	22	15	889	883
	23	23	826	791
	24	19	838	796
	27	30	939	930
3	5	12	1222	1237
	7	16	1033	1011
	8	16	964	955
	9	19	1100	1066
	10	21	832	803
	11	23	759	706
	15	10	1273	1253
	16	15	875	814

TABLE 7.3 (CONTINUED)

From	To	Distance (miles)	Direct Demand	Return Demand
3	18	15	828	777
	19	20	788	742
	20	23	970	936
	23	14	797	745
	24	14	863	800
	27	38	803	776
4	7	11	1486	1425
	8	13	1418	1376
	9	13	1485	1411
	10	16	1226	1159
	11	20	1116	1017
	14	20	1134	1014
	16	10	1364	1244
	18	13	1188	1093
	19	16	1192	1100
	20	20	1469	1389
	22	10	1435	1365
	23	17	1149	1053
	24	14	1226	1113
	27	33	1268	1202
5	8	10	1193	1167
	10	10	1148	1095
	11	18	958	881
	14	14	1031	929
	16	7	1187	1091
	18	13	1011	937
	19	13	1074	999
	20	18	1342	1278
	21	11	1587	1528
	22	15	1028	985
	23	21	852	787
	24	16	994	910
	27	27	1226	1171
7	11	12	906	861
	14	12	859	801
	15	14	1242	1249
	16	12	907	862
	18	20	770	739
	19	18	861	829
	20	23	1083	1068
	21	17	1224	1219
	22	21	879	872
	24	23	770	729
	27	23	1069	1057

TABLE 7.3 (CONCLUDED)

From	To	Distance (miles)	Direct Demand	Return Demand
8	9	12	1026	1004
	10	9	918	895
	14	16	789	727
	15	17	1157	1149
	16	16	841	790
	19	22	828	787
	20	28	1029	1002
	21	19	1215	1195
	22	22	829	812
	27	25	1036	1012
9	15	12	1054	1070
	19	12	773	750
	20	18	966	960
	21	17	1054	1059
	22	22	774	774
	27	20	959	957
10	15	16	826	842
	20	23	770	770
	21	21	846	854
	27	17	817	818
11	21	27	704	737
14	15	18	744	802
	27	14	749	793
15	20	13	1136	1113
	22	11	923	910
	24	9	887	836
	27	32	778	765
16	20	12	865	897
	21	11	867	909
18	21	8	925	961
19	21	14	889	920
20	21	17	1130	1142
	22	21	724	728
	24	14	814	782
21	23	10	835	801
	27	37	741	735

ORIGIN STOLPORT

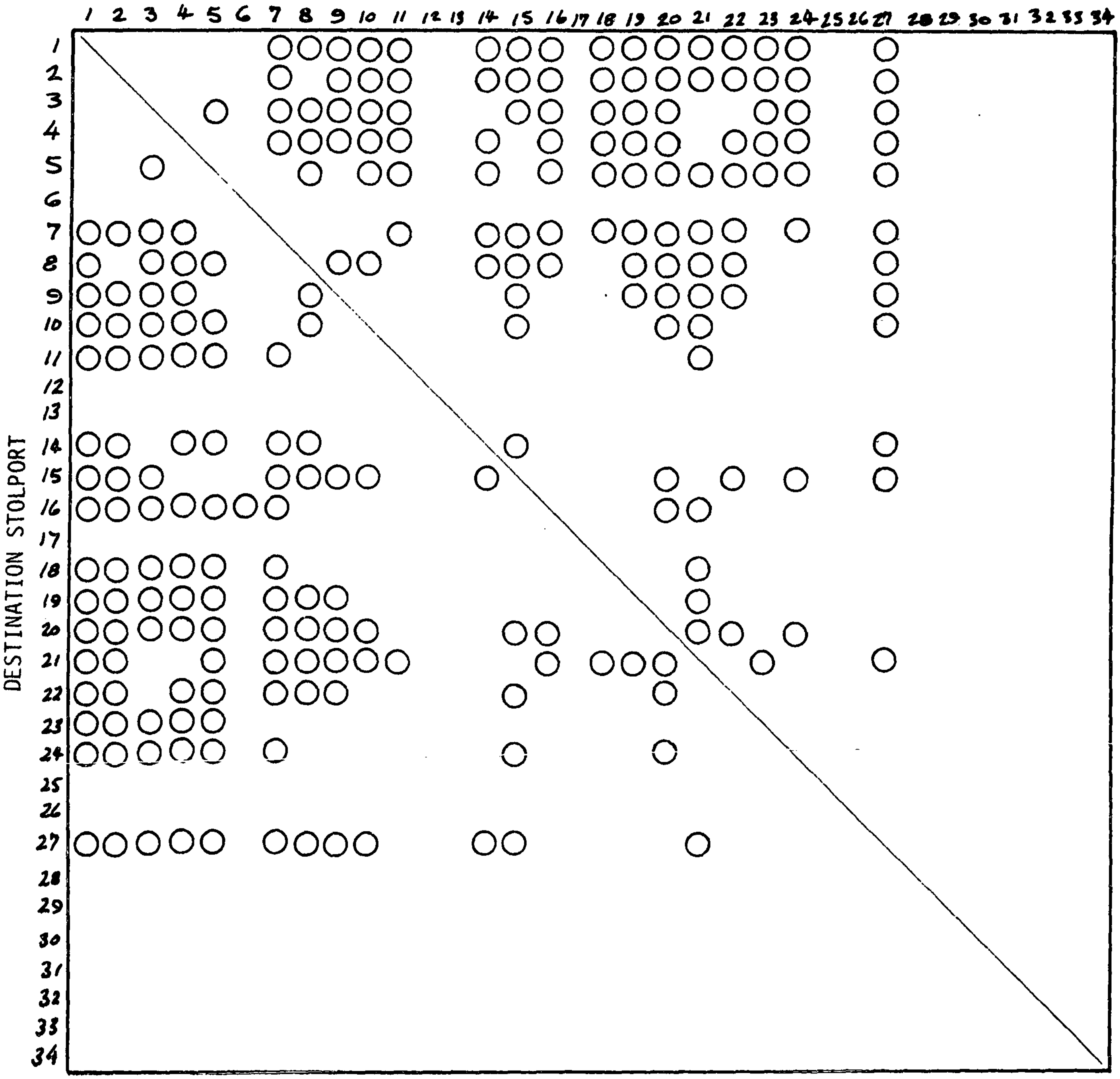


FIGURE 7.4
DETROIT LINKS SERVED BY STOL (1965)

TABLE 7.4 NETWORK MODEL RESULTS - DETROIT 40 SEAT AUGMENTOR WING STOL

FLIGHT STATISTICS

FLT NBR	HRS UTIL	PAX	WGT L.F.	L.F.	DISTANCE	REVENUE	DOC	IOC	PROFIT	CUM PRO	C.PCNT
1	10.95	2306	.780	.784	2238.4	8044.14	3580.36	0.00	4363.79	4364	.0079
2	9.81	2377	.772	.772	1443.4	8478.82	3725.33	0.00	4753.49	9117	.0173
3	9.30	2292	.733	.785	1368.3	8039.09	3559.16	0.00	4529.92	13547	.0253
4	8.89	2080	.757	.776	1384.4	7280.01	3371.20	0.00	3908.81	17556	.0345
5	9.05	2278	.842	.838	1417.5	7973.65	3419.58	0.00	4554.08	22110	.0434
6	9.89	2541	.753	.750	1157.3	9242.61	3947.61	0.00	5295.00	27405	.0538
7	9.03	2471	.821	.835	1240.3	8662.40	3530.75	0.00	5131.65	32537	.0636
8	9.43	2770	.831	.834	1154.4	9536.64	3783.24	0.00	5913.41	38450	.0745
9	9.54	2238	.871	.874	1714.9	7930.53	3430.89	0.00	4559.65	43010	.0833
10	9.35	2727	.857	.852	1188.1	9574.58	3701.43	0.00	5873.09	48883	.0940
11	10.02	2772	.731	.788	1205.2	9703.12	3970.44	0.00	5732.67	54615	.1050
12	9.25	2477	.842	.826	1292.0	8669.78	3587.99	0.00	5081.79	59697	.1147
13	8.85	2241	.844	.852	1433.5	7967.12	3329.44	0.00	4637.68	64335	.1235
14	8.75	2277	.827	.813	1254.1	7970.01	3406.91	0.00	4563.10	68898	.1325
15	9.01	2296	.822	.820	1345.3	8039.34	3450.37	0.00	4587.97	73486	.1415
16	8.75	2404	.854	.859	1247.9	8415.89	3403.99	0.00	5011.99	78498	.1510
17	9.20	2202	.831	.874	1244.1	7847.52	3173.87	0.00	4673.65	83172	.1597
18	9.45	2217	.833	.840	1525.4	8068.23	3453.47	0.00	4614.76	87785	.1684
19	8.90	2277	.831	.825	1332.6	8053.03	3411.73	0.00	4641.30	92428	.1774
20	9.59	2524	.834	.875	1415.3	9377.25	3646.73	0.00	5730.52	98158	.1877
21	8.84	2284	.810	.816	1282.4	7998.59	3420.42	0.00	4578.17	102736	.1967
22	8.04	2089	.857	.843	1213.0	7317.98	3125.54	0.00	4191.44	106928	.2049
23	10.22	2152	.802	.791	1951.1	8021.58	3626.22	0.00	4395.36	111323	.2134
24	8.70	2102	.830	.847	1457.3	7698.59	3242.94	0.00	4455.65	115779	.2217
25	8.59	2313	.853	.863	1271.7	8114.72	3317.51	0.00	4797.21	120576	.2308
26	5.85	1573	.813	.820	1088.4	6058.62	2708.56	0.00	3350.06	123926	.2374
27	8.44	2075	.757	.785	1248.9	7295.51	3274.07	0.00	4021.44	127948	.2456
28	8.16	2242	.856	.862	1171.6	7851.73	3204.63	0.00	4647.10	132595	.2544
29	8.42	2453	.835	.839	1154.0	8585.39	3326.64	0.00	5258.76	137853	.2640
30	8.89	2370	.825	.823	1243.7	8348.99	3467.17	0.00	4881.82	142735	.2734
31	9.52	2266	.825	.821	1191.6	7933.21	3344.57	0.00	4588.64	147324	.2823
32	7.72	2134	.881	.877	1207.5	7229.49	2993.53	0.00	4235.95	151560	.2903
33	8.42	2313	.826	.838	1154.7	8098.37	3326.98	0.00	4771.39	156331	.2994
34	8.71	2523	.846	.852	1119.6	8828.99	3473.23	0.00	5355.75	161687	.3094
35	8.62	2125	.750	.728	1115.5	7512.94	3438.68	0.00	4074.26	165761	.3177
36	8.80	2555	.852	.852	1126.1	8943.03	3508.93	0.00	5434.10	171195	.3278
37	9.20	2561	.848	.843	1245.2	8973.37	3598.31	0.00	5375.06	176570	.3379
38	7.84	2280	.857	.864	1027.3	7980.32	3168.44	0.00	4811.88	181382	.3468
39	8.46	2492	.871	.877	1112.3	8722.27	3371.95	0.00	5350.31	186733	.3567
40	8.05	2267	.856	.859	1103.4	7935.06	3204.73	0.00	4730.34	191463	.3656
41	9.03	1959	.814	.790	1209.4	6995.9	3124.82	0.00	3871.09	195334	.3733
42	9.22	2569	.853	.855	1195.2	9356.94	3639.65	0.00	5717.29	201051	.3838
43	8.71	2338	.799	.801	1148.5	8182.89	3454.41	0.00	4728.48	205780	.3930
44	6.42	1585	.802	.810	899.7	5937.27	2651.25	0.00	3286.02	209065	.3996
45	7.61	2131	.825	.832	996.9	7474.12	3088.75	0.00	4385.37	213451	.4080
46	8.34	2276	.846	.849	1181.7	7967.64	3274.63	0.00	4693.00	218144	.4170
47	8.33	2190	.820	.830	1223.5	7666.31	3264.81	0.00	4401.50	222546	.4256
48	7.83	2224	.814	.813	963.1	7784.94	3203.09	0.00	4581.85	227128	.4344
49	9.35	2509	.931	.925	1220.1	9132.88	3684.13	0.00	5448.75	232576	.4447
50	9.12	2392	.851	.853	1017.2	8363.59	3294.05	0.00	5069.54	237646	.4541
51	8.85	2536	.879	.867	1120.2	9224.27	3538.74	0.00	5685.52	243331	.4645
52	6.34	1595	.792	.800	840.5	5948.22	2655.68	0.00	3292.54	246624	.4711
53	7.94	2150	.840	.840	1120.8	7524.21	3147.79	0.00	4376.41	251000	.4796
54	5.10	1508	.798	.804	837.7	5662.30	2556.50	0.00	3105.80	254106	.4859
55	7.67	2188	.820	.823	960.7	7658.58	3135.72	0.00	4521.86	258628	.4945

TABLE 7.4 (CONTINUED)

56	5.87	1590	.853	.945	836.1	5563.33	2457.97	0.00	3105.36	261733	.5008
57	9.20	2557	.870	.976	950.5	8950.04	3364.91	0.00	5585.24	267319	.5109
58	5.53	1764	.826	.917	918.4	5173.10	2725.35	0.00	3447.75	270766	.5178
59	7.20	2160	.846	.944	932.5	7210.51	2950.23	0.00	4250.23	275017	.5259
60	5.11	1535	.795	.901	811.4	5722.09	2576.59	0.00	3145.50	278162	.5324
61	8.13	2304	.827	.923	1043.2	9054.15	3306.43	0.00	4757.72	282920	.5414
62	9.11	2414	.834	.936	953.5	8447.73	3328.91	0.00	5118.83	288039	.5509
63	5.42	1462	.813	.912	727.7	5117.37	2341.11	0.00	2776.27	290815	.5567
64	7.67	2282	.853	.954	960.9	7936.30	3136.83	0.00	4849.46	295664	.5657
65	5.32	1535	.752	.857	805.8	5720.86	2571.70	0.00	3049.16	298714	.5721
66	7.07	1370	.805	.907	881.4	5395.08	2935.93	0.00	3959.15	302673	.5799
67	4.95	1333	.739	.913	655.9	4579.48	2181.73	0.00	2497.75	305170	.5851
68	4.80	1195	.749	.766	659.6	4199.24	2117.91	0.00	2081.43	307252	.5898
69	4.97	1097	.819	.932	558.4	5239.59	2260.42	0.00	2979.17	310231	.5957
70	5.30	1788	.809	.928	798.0	6259.45	2668.02	0.00	3591.43	313822	.6028
71	7.02	1947	.752	.769	894.0	6464.81	2909.32	0.00	3555.49	317378	.6101
72	4.33	1379	.755	.770	509.3	3806.87	1958.22	0.00	1848.65	319227	.6143
73	4.75	1269	.751	.771	591.5	4442.63	2145.83	0.00	2296.80	321523	.6193
74	4.33	1163	.758	.738	646.0	3750.93	2073.93	0.00	1676.35	323200	.6235
75	7.10	1309	.795	.792	992.0	5681.23	2940.99	0.00	3740.24	326941	.6310
76	6.15	1568	.791	.787	771.2	5938.29	2522.62	0.00	3215.58	330156	.6376
77	5.81	1477	.847	.858	556.9	5168.12	2194.49	0.00	2973.62	333130	.6434
78	6.59	1328	.813	.802	846.5	5412.15	2921.57	0.00	3590.59	336720	.6506
79	5.97	1517	.799	.809	788.8	5659.81	2533.22	0.00	3126.59	339847	.6569
80	7.30	1380	.791	.811	959.2	6937.08	2977.78	0.00	3959.30	343806	.6647
81	5.30	1248	.716	.726	739.3	4338.32	2281.42	0.00	2106.90	345913	.6696
82	5.84	1473	.734	.737	775.0	5171.02	2559.23	0.00	2611.79	348525	.6754
83	4.61	1111	.693	.595	557.3	3897.79	2101.66	0.00	1796.13	350321	.6798
84	5.41	1244	.651	.575	695.1	4366.35	2358.15	0.00	2008.20	352329	.6847
85	6.55	1715	.755	.756	974.0	5003.58	2769.41	0.00	3234.17	355564	.6915
86	5.53	1439	.758	.782	737.7	5045.10	2378.46	0.00	2666.65	358230	.6971
87	5.75	1443	.729	.736	738.4	5049.87	2476.62	0.00	2573.24	360803	.7028
88	5.13	1536	.750	.757	754.5	5726.32	2547.29	0.00	3079.03	363882	.7093
89	4.49	1150	.736	.757	581.3	4025.86	2043.16	0.00	1982.70	365865	.7138
90	4.04	921	.658	.539	469.9	3222.60	1924.86	0.00	1297.74	367163	.7174
91	4.91	1329	.755	.773	628.7	4652.74	2261.30	0.00	2391.44	369554	.7227
92	5.70	1425	.721	.727	751.2	4986.95	2515.31	0.00	2471.53	372026	.7283
93	4.79	1175	.720	.715	573.7	4112.19	2250.15	0.00	1862.03	373888	.7329
94	3.29	758	.678	.576	522.8	2651.79	1787.03	0.00	864.71	374753	.7359
95	5.37	1398	.723	.760	747.0	4893.81	2448.11	0.00	2445.70	377198	.7414
96	5.05	1256	.711	.746	679.5	4405.18	2220.34	0.00	2184.84	379383	.7463
97	4.05	1055	.728	.733	541.1	3593.57	2023.98	0.00	1569.59	381053	.7505
98	4.99	1353	.750	.786	695.1	4740.65	2321.29	0.00	2419.36	383472	.7558
99	5.03	1187	.656	.590	538.6	4163.74	2233.44	0.00	1930.30	385403	.7605
100	3.43	928	.703	.714	576.9	2899.53	1878.03	0.00	1021.50	386424	.7637
101	3.49	594	.602	.520	594.6	2444.08	1853.89	0.00	590.19	387014	.7665
102	3.51	920	.724	.707	574.0	2916.18	1989.49	0.00	926.59	387941	.7697
103	2.95	514	.637	.540	577.1	2193.47	1993.21	0.00	300.26	388241	.7721
104	3.43	961	.701	.742	546.2	3035.51	1976.27	0.00	1059.24	389300	.7755
105	4.23	1346	.722	.726	907.0	3677.76	2346.27	0.00	1331.49	390632	.7796
106	4.91	1361	.744	.773	701.0	4770.32	2426.15	0.00	2344.16	392976	.7850
107	4.17	980	.674	.580	719.9	3429.33	2239.53	0.00	1188.75	394165	.7888
108	3.14	766	.705	.584	564.1	2580.44	1904.56	0.00	775.88	394941	.7919
109	3.39	778	.571	.527	539.2	2721.83	2103.34	0.00	618.49	395559	.7949
110	3.92	901	.615	.563	717.8	3161.40	2205.99	0.00	955.41	396515	.7985
111	3.65	955	.650	.568	553.7	2932.55	1932.19	0.00	1060.36	397575	.8018
112	2.90	550	.605	.550	528.0	2275.92	1902.41	0.00	373.51	397948	.8044

TABLE 7.4 (CONTINUED)

113	2.93	778	.703	.720	606.8	2721.55	1957.48	0.00	764.07	398713	.8075
114	3.23	731	.599	.553	598.7	2559.32	2066.49	0.00	492.93	399205	.8103
115	3.25	543	.590	.595	569.4	2250.25	1954.74	0.00	295.51	399501	.8129
116	2.79	578	.633	.707	478.9	2374.69	1568.34	0.00	706.35	400207	.8155
117	3.17	498	.438	.498	594.3	1761.44	1755.94	0.00	5.51	400213	.8175
118	2.85	537	.687	.564	540.3	2231.09	1875.67	0.00	355.42	400568	.8200
119	2.83	511	.551	.556	595.1	1790.01	1755.30	0.00	33.72	400602	.8220
120	2.54	478	.575	.559	574.8	1673.95	1714.06	0.00	-40.10	400562	.8239
121	2.72	500	.524	.568	582.0	1752.17	1717.48	0.00	34.69	400596	.8259
122	3.70	748	.524	.584	593.6	2616.80	1983.79	0.00	633.01	401229	.8288
123	2.71	494	.511	.561	611.1	1728.32	1763.95	0.00	-35.63	401194	.8308
124	2.24	449	.548	.561	425.8	1570.69	1545.25	0.00	25.43	401219	.8325
125	1.98	326	.439	.480	417.7	1142.04	1443.61	0.00	-301.55	400918	.8338
126	2.43	420	.455	.500	537.2	1468.55	1696.12	0.00	-227.57	400690	.8355
127	3.00	520	.493	.520	667.3	1821.20	1921.10	0.00	-99.90	400590	.8375
128	2.90	371	.374	.387	558.5	1305.77	1738.91	0.00	-433.13	400157	.8390
129	3.04	485	.443	.467	487.1	1702.11	1704.84	0.00	-2.73	400154	.8409
130	2.93	413	.392	.430	569.0	1454.05	1743.89	0.00	-289.84	399865	.8425
131	2.23	427	.525	.552	503.8	1493.83	1582.40	0.00	-88.57	399776	.8442
132	2.56	456	.525	.518	588.7	1594.55	1785.83	0.00	-191.23	399585	.8460
133	2.55	496	.553	.563	418.1	1734.98	1541.57	0.00	193.41	399778	.8480
134	1.87	321	.538	.535	499.1	1125.75	1481.87	0.00	-355.12	399423	.8492
135	2.10	331	.425	.435	459.9	1156.95	1463.69	0.00	-306.74	399116	.8505
136	2.91	391	.352	.407	528.9	1387.90	1692.19	0.00	-304.29	398812	.8521
137	2.65	342	.431	.388	493.4	1138.78	1510.04	0.00	-411.25	398401	.8534
138	2.05	309	.398	.429	349.9	1080.79	1378.67	0.00	-297.88	398103	.8546
139	2.29	395	.498	.520	573.9	1381.88	1681.02	0.00	-299.15	397804	.8562
140	2.10	366	.473	.509	438.6	1281.76	1579.92	0.00	-298.16	397506	.8576
141	2.24	196	.258	.272	352.2	686.26	1314.55	0.00	-628.30	396877	.8584
142	2.39	455	.526	.541	581.9	1591.15	1782.61	0.00	-191.45	396685	.8602
143	2.50	522	.555	.593	698.3	1825.58	1968.49	0.00	-142.92	396543	.8622
144	2.07	250	.331	.367	348.9	873.72	1312.98	0.00	-439.26	396104	.8632
145	3.17	381	.367	.366	599.2	1332.19	1823.45	0.00	-491.25	395612	.8647
146	2.37	301	.377	.377	474.4	1055.55	1568.40	0.00	-512.85	395100	.8659
147	2.15	294	.492	.408	449.6	1029.03	1491.39	0.00	-462.36	394637	.8671
148	2.44	369	.431	.440	570.7	1292.53	1744.67	0.00	-452.14	394185	.8685
149	2.77	400	.476	.417	577.1	1401.54	1812.95	0.00	-411.41	393774	.8701
150	1.57	194	.309	.373	376.3	678.05	1293.45	0.00	-615.40	393158	.8708
151	2.84	370	.448	.433	628.8	1296.10	1804.95	0.00	-508.85	392649	.8723
152	2.12	255	.343	.375	503.0	899.60	1515.85	0.00	-618.25	392031	.8733
153	1.78	275	.481	.528	522.2	966.42	1428.18	0.00	-461.75	391569	.8744
154	1.33	279	.658	.533	414.5	975.59	1311.67	0.00	-336.08	391233	.8755
155	.98	211	.528	.560	335.3	739.21	1143.54	0.00	-404.33	390829	.8763
156	.94	231	.598	.722	320.1	809.47	1136.25	0.00	-327.79	390501	.8772
157	.94	269	.654	.840	354.5	940.95	1185.27	0.00	-244.33	390257	.8783
158	1.08	274	.756	.752	378.5	959.90	1229.29	0.00	-269.39	389987	.8794
159	.82	167	.420	.598	239.0	586.21	999.85	0.00	-413.64	389574	.8800
160	1.05	272	.579	.755	370.2	951.09	1225.34	0.00	-274.25	389300	.8811
161	1.17	267	.615	.556	381.5	935.52	1263.34	0.00	-327.82	388972	.8822
162	.91	267	.588	.335	340.9	935.00	1178.75	0.00	-243.75	388728	.8832
163	1.13	273	.683	.581	366.7	953.97	1256.29	0.00	-302.32	388426	.8843
164	1.13	251	.642	.526	330.0	879.90	1159.29	0.00	-280.39	388145	.8853
165	1.03	285	.578	.791	359.1	996.69	1220.04	0.00	-223.34	387922	.8864
166	.93	268	.709	.939	369.9	939.62	1192.61	0.00	-252.99	387669	.8874
167	1.10	253	.721	.704	351.6	885.43	1183.88	0.00	-297.44	387372	.8884
168	1.32	324	.523	.737	374.0	1135.36	1259.76	0.00	-124.40	387247	.8897
169	.97	245	.606	.755	330.7	858.18	1141.32	0.00	-283.14	386364	.8907

TABLE 7.4 (CONTINUED)

170	.93	248	.531	.751	318.4	840.67	1135.46	0.00	-294.79	386669	.8916
171	.93	242	.542	.755	338.7	845.49	1145.15	0.00	-299.66	386370	.8926
172	1.09	249	.640	.592	341.9	872.42	1179.25	0.00	-306.93	386063	.8936
173	.95	246	.540	.759	329.1	861.44	1140.57	0.00	-279.12	385784	.8945
174	1.17	301	.698	.753	382.3	1054.66	1263.70	0.00	-209.04	385575	.8957
175	1.14	301	.718	.753	371.8	1054.71	1258.71	0.00	-204.00	385371	.8969
176	1.02	254	.550	.765	319.9	889.22	1168.73	0.00	-280.52	385090	.8979
177	.83	242	.513	.756	301.7	846.69	1127.50	0.00	-280.80	384809	.8989
178	.83	246	.491	.769	301.4	860.81	1127.37	0.00	-266.56	384543	.8998
179	.87	188	.541	.559	259.6	659.60	1074.83	0.10	-415.23	384127	.9006
180	.73	186	.411	.535	255.4	651.76	1040.22	0.00	-388.47	383733	.9013

TABLE 7.4 (CONCLUDED)

DAILY SUMMARY

Mean utilization, hours	5.04
Standard deviation of utilization, hours	2.96
Load factor	.76
Total passengers carried	228,877.
Total direct operating cost, dollars	421,724.
Total indirect operating cost, dollars	108,868.
Total revenue, dollars	805,463.
Total profit, dollars	274,871.
Mean passenger wait time, minutes	13.29
Total demand	253,939.
Percent demand carried	90.13
Total revenue flights	7,467.
Total distance flown, miles	140,429.
Total revenue passenger miles flown	3,778,831.
Number ferry flights	505.
Total distance ferried, miles	16,221.
Profit per passenger, dollars	1.20
Fleet size	180.
Total gates required	104

TABLE 7.5 - NETWORK MODEL RESULTS - DETROIT 60 SEAT AUGMENTOR WING STOL

FLIGHT STATISTICS

FLT NBR	HRS UTIL	PAX	WGT L.F.	L.F.	DISTANCE	REVENUE	DOC	IOC	PROFIT	CUM PRO	C.PCNT
1	10.23	2524	.678	.568	2319.1	9887.39	4010.92	0.00	5877.07	5877	.0099
2	9.37	3158	.702	.702	1336.6	11148.22	4087.03	0.00	7061.20	12938	.0224
3	8.54	3231	.737	.728	1058.3	11310.05	3900.04	0.00	7410.01	20348	.0351
4	8.53	3353	.714	.717	1138.9	10711.81	3832.48	0.00	6879.33	27228	.0471
5	9.02	3394	.729	.725	1122.2	11878.01	4082.47	0.00	7795.54	35023	.0605
6	9.52	3523	.723	.746	1221.6	12695.66	4247.03	0.00	8448.63	43472	.0748
7	8.95	3366	.716	.730	1325.0	10732.09	3895.75	0.00	6836.34	50308	.0868
8	9.21	3154	.746	.740	1389.7	11162.55	3967.65	0.00	7194.90	57503	.0992
9	8.72	3323	.799	.775	1380.2	10582.63	3740.51	0.00	6842.12	64345	.1112
10	9.36	3229	.835	.815	1589.7	11590.32	3890.43	0.00	7699.89	72045	.1239
11	8.05	2367	.731	.735	1134.9	10050.59	3508.32	0.00	6442.28	78487	.1352
12	8.98	2759	.735	.742	1561.5	10068.25	3727.27	0.00	6340.98	84828	.1460
13	8.29	2306	.776	.781	1308.5	10376.57	3590.87	0.00	6785.70	91514	.1575
14	8.54	3346	.751	.757	1257.4	10668.20	3748.32	0.00	6919.88	98534	.1694
15	8.15	2392	.759	.767	1169.6	10475.22	3627.00	0.00	6848.23	105382	.1812
16	7.67	2335	.763	.750	1047.1	9926.39	3486.97	0.00	6439.42	111822	.1924
17	8.07	2399	.751	.755	1168.4	10151.17	3589.35	0.00	6561.82	118383	.2038
18	8.04	2365	.778	.770	1214.3	10290.00	3540.12	0.00	6749.88	125133	.2151
19	8.11	2373	.754	.766	1213.0	10207.95	3576.43	0.00	6631.52	131765	.2264
20	7.90	2340	.759	.778	1133.9	10307.09	3533.78	0.00	6773.31	138538	.2380
21	7.08	2601	.745	.741	1084.2	8578.04	3173.97	0.00	5404.08	143942	.2474
22	7.65	2320	.757	.748	1040.1	9962.30	3483.19	0.00	6479.11	150421	.2586
23	5.83	1312	.743	.741	943.0	6335.40	2590.88	0.00	4245.52	154667	.2661
24	8.49	3140	.751	.759	1181.1	10996.76	3781.22	0.00	7215.54	161882	.2785
25	7.99	3330	.731	.783	1082.6	10821.37	3617.14	0.00	7204.23	169087	.2906
26	7.73	2739	.737	.733	1091.3	9808.32	3510.82	0.00	6297.50	175384	.3016
27	7.52	2226	.795	.787	1021.1	10242.44	3435.98	0.00	6806.46	182191	.3131
28	8.85	3399	.765	.755	1148.6	11897.95	3985.72	0.00	7912.23	190103	.3265
29	7.98	3319	.792	.774	1106.4	10669.80	3592.95	0.00	7076.85	197180	.3384
30	8.07	3212	.759	.776	1026.5	11240.71	3697.88	0.00	7542.82	204722	.3511
31	8.35	3360	.737	.741	1129.4	10766.57	3753.37	0.00	7013.30	211736	.3632
32	8.63	3340	.740	.744	1052.5	11719.94	3939.30	0.00	7780.64	219516	.3763
33	7.77	3121	.792	.800	1026.9	10960.01	3550.10	0.00	7409.91	226926	.3886
34	8.44	3371	.782	.780	1078.2	11797.49	3836.73	0.00	7960.77	234887	.4019
35	7.22	2789	.774	.780	997.0	9827.51	3312.00	0.00	6515.53	241403	.4129
36	7.54	2753	.740	.740	1028.4	9677.57	3439.88	0.00	6237.69	247640	.4237
37	5.43	1341	.751	.752	807.8	6811.66	2618.02	0.00	4193.64	251834	.4314
38	8.03	3356	.759	.760	1089.9	10709.8	3658.05	0.00	7051.76	258886	.4434
39	7.86	3378	.759	.766	1004.0	10771.84	3611.77	0.00	7160.07	266046	.4555
40	8.11	3295	.758	.774	982.9	11534.12	3748.38	0.00	7785.74	273832	.4685
41	7.81	3337	.781	.779	1044.3	10628.55	3559.49	0.00	7069.06	280901	.4805
42	6.91	2645	.713	.728	964.2	8601.49	3183.32	0.00	5418.17	286319	.4901
43	7.60	3014	.767	.773	964.6	10548.22	3516.54	0.00	7031.68	293350	.5020
44	7.05	2756	.751	.755	902.1	9645.11	3297.81	0.00	6347.29	299698	.5128
45	4.98	1752	.692	.597	648.3	6204.47	2495.01	0.00	3709.46	303407	.5197
46	7.10	2321	.778	.771	894.1	9872.03	3330.50	0.00	6541.58	309949	.5308
47	7.07	2311	.758	.768	883.3	9837.32	3324.72	0.00	6512.60	316461	.5419
48	5.95	2159	.705	.734	808.3	7595.21	2840.28	0.00	4754.93	321216	.5504
49	5.52	2334	.736	.721	706.8	7144.05	2711.58	0.00	4432.47	325649	.5584
50	5.03	1347	.697	.733	557.2	5489.81	2505.24	0.00	3984.57	329633	.5657
51	5.25	2606	.776	.785	803.8	8735.45	2989.11	0.00	5746.35	335380	.5755
52	6.77	2506	.732	.733	887.0	8769.74	3178.63	0.00	5591.05	340971	.5854
53	4.13	1513	.702	.721	555.1	5311.83	2186.34	0.00	3125.49	344096	.5913
54	5.23	1769	.654	.570	686.4	6199.54	2589.59	0.00	3609.95	347706	.5983
55	5.24	2306	.712	.725	804.3	8071.60	2986.09	0.00	5085.51	352792	.6074

TABLE 7.5 (CONTINUED)

56	3.94	1387	.652	.590	492.6	4879.07	2115.08	0.00	2763.98	355556	.6129
57	6.13	2152	.713	.703	873.4	7548.80	2986.35	0.00	4562.45	360118	.6213
58	4.22	1489	.698	.709	567.4	5210.64	2192.42	0.00	3018.22	363136	.6272
59	5.24	2414	.746	.745	773.3	8450.22	3006.75	0.00	5443.47	368580	.6367
60	4.52	1594	.645	.599	592.9	5590.56	2317.19	0.00	3273.36	371853	.6430
61	5.10	1380	.707	.712	639.4	6573.25	2563.71	0.00	4015.54	375869	.6504
62	4.15	1366	.645	.550	540.3	4780.59	2178.17	0.00	2602.52	378471	.6558
63	4.92	1743	.658	.591	626.4	6098.90	2483.23	0.00	3615.67	382087	.6626
64	5.09	1341	.673	.597	532.2	5442.25	2560.38	0.00	3881.87	385969	.6699
65	4.43	1595	.749	.724	583.6	5932.46	2386.18	0.00	3546.28	389515	.6765
66	5.35	1753	.622	.549	737.6	6140.59	2591.19	0.00	3449.40	392964	.6834
67	3.45	1234	.687	.585	422.2	4318.07	1929.16	0.00	2398.91	395353	.6883
68	4.22	1497	.678	.593	538.1	5239.91	2213.65	0.00	3026.26	398380	.6942
69	4.61	1512	.624	.530	568.3	5293.22	2377.90	0.00	2915.31	401295	.7002
70	3.69	1275	.695	.585	479.0	4462.52	1996.80	0.00	2465.72	403761	.7052
71	4.12	1289	.617	.532	623.4	4544.48	2259.64	0.00	2284.94	406046	.7103
72	4.17	1146	.543	.562	612.0	4011.04	2216.47	0.00	1794.57	407840	.7148
73	4.66	1578	.652	.599	719.0	5906.95	2607.16	0.00	3299.79	411140	.7214
74	3.57	1186	.635	.559	635.9	4231.92	2229.88	0.00	2002.04	413142	.7250
75	3.31	1390	.607	.527	533.0	3815.97	2039.87	0.00	1716.11	414858	.7303
76	2.55	727	.557	.577	516.5	2562.40	1832.01	0.00	730.40	415588	.7332
77	3.21	790	.459	.488	521.7	2765.05	1982.80	0.00	782.25	416371	.7363
78	3.13	378	.528	.563	653.9	3073.35	2165.06	0.00	908.29	417279	.7398
79	4.54	1572	.632	.555	541.9	5503.17	2363.70	0.00	3139.47	420418	.7460
80	2.92	305	.554	.503	571.4	3174.48	2046.60	0.00	1127.88	421546	.7495
81	2.97	346	.540	.507	592.3	3312.52	2131.85	0.00	1180.66	422727	.7533
82	2.60	534	.501	.503	592.2	2124.06	1872.78	0.00	251.28	422978	.7556
83	3.63	1361	.529	.570	461.6	3724.35	1987.41	0.00	1736.94	424715	.7598
84	2.70	591	.530	.523	574.2	2416.93	1937.08	0.00	479.85	425195	.7625
85	2.85	523	.441	.432	543.5	2179.79	1957.56	0.00	222.23	425417	.7650
86	2.35	703	.587	.536	502.2	2460.08	1824.23	0.00	635.79	426053	.7677
87	3.75	1151	.551	.539	747.7	4028.95	2474.64	0.00	1554.32	427607	.7723
88	3.14	396	.555	.575	721.9	3138.30	2275.71	0.00	862.58	428470	.7758
89	3.43	924	.501	.531	701.3	3253.21	2301.61	0.00	951.59	429422	.7794
90	4.60	1339	.438	.444	525.5	3635.56	2408.76	0.00	1226.80	430648	.7835
91	3.43	729	.370	.392	573.3	2553.00	2232.62	0.00	320.38	430969	.7864
92	2.74	531	.427	.457	559.4	2209.93	1966.12	0.00	243.82	431213	.7889
93	3.84	983	.416	.475	574.7	3120.15	2250.28	0.00	869.86	432082	.7924
94	3.55	590	.363	.393	563.7	2423.75	2116.45	0.00	307.33	432390	.7951
95	2.97	511	.421	.438	522.1	2140.00	2110.93	0.00	29.07	432419	.7975
96	3.13	709	.422	.455	540.4	2483.14	1992.90	0.00	490.24	432909	.8003
97	3.93	715	.336	.372	743.5	2513.85	2398.36	0.00	115.49	433025	.8031
98	2.83	712	.482	.494	585.9	2499.30	2054.93	0.00	444.38	433469	.8059
99	2.52	588	.427	.446	372.7	2058.78	1580.48	0.00	378.30	433847	.8082
100	1.90	543	.459	.532	454.4	1899.74	1724.50	0.00	175.24	434022	.8104
101	3.00	735	.410	.471	505.9	2573.59	2139.20	0.00	434.49	434457	.8133
102	2.83	530	.335	.358	449.7	1859.72	1796.00	0.00	63.72	434521	.8153
103	2.25	599	.505	.526	457.6	2097.29	1726.23	0.00	371.06	434892	.8177
104	2.43	424	.357	.354	395.8	1485.25	1619.48	0.00	-134.21	434758	.8194
105	2.43	327	.238	.273	431.8	1145.9.	1675.31	0.00	-529.40	434228	.8207
106	1.97	290	.319	.302	339.5	1015.83	1440.58	0.00	-424.75	433803	.8218
107	2.07	334	.355	.348	411.1	1180.92	1516.19	0.00	-335.27	433468	.8231
108	2.32	285	.251	.250	386.7	1002.1	1577.04	0.00	-574.86	432893	.8243
109	2.63	390	.312	.296	381.8	1366.29	1648.43	0.00	-282.15	432611	.8258
110	2.40	378	.332	.315	386.9	1324.60	1614.15	0.00	-289.55	432322	.8273
111	2.93	370	.270	.257	489.4	1312.85	1817.37	0.00	-504.51	431817	.8287
112	3.02	408	.267	.272	572.7	1429.87	2010.23	0.00	-581.43	431236	.8303

TABLE 7.5 (CONTINUED)

113	2.22	333	.319	.308	443.3	1165.68	1544.54	0.00	-478.87	430757	.8317
114	2.65	438	.373	.332	488.0	1534.06	1816.62	0.00	-282.55	430474	.8334
115	2.25	271	.240	.238	351.1	949.44	1563.22	0.00	-614.79	429859	.8344
116	2.27	290	.247	.254	431.4	1021.65	1575.15	0.00	-653.50	429206	.8356
117	1.33	292	.330	.443	400.8	1028.57	1436.62	0.00	-408.05	428798	.8367
118	2.23	296	.253	.275	413.7	1047.72	1591.59	0.00	-543.87	428254	.8379
119	1.13	266	.356	.443	234.4	923.76	1252.87	0.00	-333.11	427921	.8390
120	1.14	350	.490	.584	305.8	1226.29	1311.42	0.00	-85.13	427836	.8403
121	1.44	302	.401	.420	356.9	1068.87	1412.96	0.00	-344.09	427492	.8415
122	.92	326	.503	.580	314.2	1142.32	1278.98	0.00	-136.66	427355	.8428
123	.93	298	.434	.551	244.7	1042.16	1204.43	0.00	-162.33	427193	.8440
124	1.24	349	.474	.529	344.9	1221.29	1406.49	0.00	-185.20	427007	.8454
125	.94	341	.432	.710	319.7	1193.42	1281.90	0.00	-88.47	426919	.8467
126	.93	345	.537	.719	318.0	1208.42	1281.02	0.00	-72.60	426846	.8481
127	1.03	327	.573	.582	353.9	1146.21	1300.37	0.00	-154.16	426692	.8493
128	1.03	397	.637	.735	344.4	1389.49	1332.23	0.00	57.26	426749	.8509
129	.83	288	.552	.596	275.0	1008.72	1183.80	0.00	-175.09	426574	.8520
130	.95	300	.627	.525	293.2	1050.53	1230.63	0.00	-180.10	426394	.8532
131	.84	297	.530	.707	277.1	1039.38	1184.95	0.00	-145.86	426248	.8544
132	.83	303	.531	.722	276.2	1061.07	1184.49	0.00	-123.42	426125	.8556
133	.91	367	.597	.765	310.8	1285.19	1277.10	0.00	8.09	426133	.8570
134	.93	346	.545	.720	315.9	1210.38	1279.88	0.00	-69.50	426064	.8584
135	.81	276	.406	.557	268.6	966.45	1180.36	0.00	-213.91	425850	.8595

TABLE 7.5 (CONCLUDED)

DAILY SUMMARY

Mean utilization, hours	4.83
Standard deviation of utilization, hours	2.71
Load factor	.67
Total passengers carried	218,257.
Total direct operating cost, dollars	342,217.
Total indirect operating cost, dollars	92,745.
Total revenue, dollars	768.067.
Total profit, dollars	333,105.
Mean passenger wait time, minutes	13.77
Total demand	253,939.
Percent demand carried	85.95
Total revenue flights	5,356.
Total distance flown, miles	98,751.
Total revenue passenger miles flown	3,603,392.
Number ferry flights	296.
Total distance ferried, miles	9,360.
Profit per passenger, dollars	1.53
Fleet size	135
Total gates required	80

TABLE 7.6 - NETWORK MODEL RESULTS - DETROIT 80 SEAT AUGMENTOR WING STOL

FLIGHT STATISTICS

FLT NBR	HRS UTIL	PAX	WGT L.F.	L.F.	DISTANCE	REVENUE	DOC	IOC	PROFIT	CUM PRO	C.PCNT
1	9.23	3238	.634	.523	1571.5	12028.15	4307.20	0.00	7720.95	7721	.0127
2	8.71	3406	.640	.535	1320.3	12064.20	4239.84	0.00	7824.35	15545	.0262
3	7.89	3335	.651	.541	1068.5	11692.63	4005.43	0.00	7687.14	23232	.0393
4	8.12	3407	.705	.587	1245.3	11978.57	3986.44	0.00	7992.13	31225	.0527
5	7.72	3382	.717	.715	1152.5	12027.71	3847.43	0.00	8180.28	39405	.0660
6	7.69	3473	.650	.568	995.0	12155.15	3961.87	0.00	8193.27	47598	.0797
7	8.03	3757	.704	.591	1038.3	13168.85	4112.32	0.00	9056.53	56655	.0945
8	7.32	3026	.692	.575	1116.9	10778.42	3659.25	0.00	7119.17	63774	.1064
9	8.05	3322	.656	.559	1191.1	11817.97	3995.58	0.00	7822.39	71596	.1195
10	7.70	3167	.633	.549	1114.5	11090.49	3866.26	0.00	7224.23	78820	.1320
11	7.93	3364	.699	.701	1229.9	12062.85	3893.87	0.00	8168.98	86989	.1452
12	7.14	3046	.701	.592	1079.1	10895.75	3594.97	0.00	7300.78	94290	.1572
13	7.62	3173	.641	.550	1086.0	11155.75	3849.17	0.00	7306.57	101597	.1697
14	7.41	3231	.692	.585	1054.6	11310.98	3753.01	0.00	7557.97	109155	.1824
15	7.44	3320	.693	.592	1049.5	11637.26	3785.66	0.00	7851.60	117006	.1955
16	7.30	3189	.674	.576	1025.1	11217.89	3729.26	0.00	7488.62	124495	.2081
17	7.93	3198	.651	.555	1222.5	11455.76	3931.11	0.00	7524.65	132020	.2207
18	7.21	3243	.695	.587	993.4	11351.32	3710.25	0.00	7641.07	139661	.2334
19	7.23	3017	.649	.550	1026.2	10582.06	3688.23	0.00	6893.83	146555	.2453
20	6.52	2364	.679	.596	979.1	10409.55	3433.27	0.00	6976.28	153531	.2570
21	7.42	3196	.670	.566	1041.5	11272.76	3780.82	0.00	7491.94	161023	.2696
22	7.74	3287	.658	.553	1103.6	11633.53	3901.40	0.00	7732.13	168755	.2825
23	5.03	2348	.652	.538	746.7	7208.03	2770.33	0.00	4437.70	173193	.2905
24	7.01	2363	.650	.550	975.9	10371.62	3616.41	0.00	6755.21	179948	.3022
25	6.14	2335	.652	.581	793.0	9920.91	3298.26	0.00	6622.65	186570	.3134
26	5.75	2512	.693	.580	754.0	9190.80	3114.14	0.00	6076.66	192647	.3237
27	6.83	2389	.651	.567	953.0	10543.97	3560.96	0.00	6983.01	199630	.3354
28	6.93	2369	.621	.529	911.0	10389.98	3660.82	0.00	6729.16	206359	.3471
29	5.90	2726	.655	.568	732.4	9570.72	3220.20	0.00	6350.53	212710	.3579
30	5.77	2577	.639	.700	929.0	9037.49	3069.76	0.00	5967.72	218678	.3680
31	6.51	2553	.595	.514	930.5	9002.24	3380.78	0.00	5621.45	224299	.3781
32	6.47	2970	.677	.575	829.5	10425.15	3445.23	0.00	6979.92	231279	.3898
33	6.19	2943	.693	.708	814.3	10302.18	3311.01	0.00	6991.17	238270	.4013
34	6.01	2538	.623	.535	803.4	8918.02	3221.11	0.00	5696.91	243967	.4113
35	6.52	3206	.692	.715	921.5	11221.18	3482.11	0.00	7739.07	251706	.4240
36	6.40	2786	.653	.545	932.9	9751.63	3405.51	0.00	6346.13	258052	.4349
37	6.34	2553	.620	.538	970.2	9307.41	3344.57	0.00	5962.85	264015	.4454
38	7.00	3199	.658	.578	915.1	11225.74	3663.29	0.00	7562.45	271577	.4580
39	6.18	2980	.651	.579	782.2	10096.47	3333.49	0.00	6762.98	278340	.4693
40	6.75	3167	.681	.583	848.8	11084.58	3581.81	0.00	7502.77	285843	.4818
41	5.60	2464	.536	.542	703.4	8622.67	3081.37	0.00	5541.30	291385	.4915
42	5.05	2204	.643	.541	645.0	7712.52	2834.94	0.00	4877.58	296262	.5002
43	5.97	2753	.670	.588	787.6	9694.80	3211.68	0.00	6483.12	302745	.5110
44	6.15	2313	.657	.563	759.3	9844.76	3325.72	0.00	6519.04	309264	.5221
45	6.10	2573	.636	.543	791.1	9355.64	3291.14	0.00	6064.50	315329	.5326
46	5.90	2537	.634	.546	732.4	9230.15	3220.24	0.00	6009.91	321339	.5430
47	5.43	2319	.623	.544	730.0	8149.88	2968.59	0.00	5181.29	326520	.5521
48	5.27	2255	.598	.513	642.8	7891.38	2958.07	0.00	4933.31	331453	.5610
49	3.80	1509	.594	.509	468.5	5630.04	2311.62	0.00	3318.42	334772	.5673
50	3.33	1506	.625	.527	526.0	5620.15	2304.45	0.00	3315.70	338087	.5737
51	5.09	2233	.623	.534	531.0	7913.89	2967.53	0.00	4946.36	343034	.5825
52	4.72	2140	.644	.538	509.9	7141.37	2688.25	0.00	4453.12	347487	.5905
53	5.32	2321	.647	.559	718.3	8138.24	2919.98	0.00	5218.26	352705	.5996
54	4.87	2121	.612	.546	636.8	7467.13	2746.04	0.00	4721.10	357425	.6080
55	4.85	1348	.557	.577	658.9	6521.47	2717.62	0.00	3803.95	361230	.6153

TABLE 7.6 (CONTINUED)

56	4.97	1388	.555	.575	573.3	6607.73	2767.99	0.00	3839.74	365070	.6227
57	3.95	1561	.550	.574	493.6	5464.57	2368.39	0.00	3096.18	368166	.6288
58	3.85	1542	.531	.503	515.0	5414.55	2237.87	0.00	3116.68	371283	.6349
59	4.20	1592	.551	.553	530.0	5571.23	2473.56	0.00	3097.67	374380	.6412
60	2.93	383	.481	.491	395.0	3446.95	1934.12	0.00	1512.83	375893	.6451
61	3.20	1154	.522	.534	415.2	4040.21	2029.57	0.00	2010.65	377904	.6496
62	3.30	1256	.538	.582	553.2	4466.68	2237.43	0.00	2229.25	380133	.6545
63	3.90	1281	.500	.500	534.6	4495.83	2309.61	0.00	2187.21	382320	.6596
64	3.39	1289	.539	.556	498.5	4512.54	2246.28	0.00	2266.26	384587	.6647
65	3.98	1377	.475	.538	562.8	4851.34	2326.51	0.00	2524.83	387111	.6701
66	3.60	1161	.480	.500	509.5	4104.13	2169.50	0.00	1934.63	389046	.6747
67	2.83	1319	.646	.560	459.2	4617.00	2097.65	0.00	2519.35	391565	.6799
68	3.30	1108	.487	.333	482.5	3936.97	2028.30	0.00	1908.67	393474	.6842
69	2.89	1045	.480	.522	489.3	3584.22	2157.41	0.00	1526.81	395001	.6883
70	3.75	1380	.502	.523	483.5	4828.38	2362.33	0.00	2466.05	397467	.6938
71	3.01	1056	.454	.507	441.9	3689.43	2087.27	0.00	1602.16	399069	.6979
72	3.32	1004	.455	.465	527.7	3532.85	2180.45	0.00	1352.40	400421	.7019
73	4.27	1567	.436	.544	556.4	5487.67	2489.40	0.00	2998.28	403420	.7080
74	3.08	949	.429	.475	562.9	3322.55	2201.54	0.00	1121.01	404541	.7118
75	2.52	865	.510	.515	469.4	3025.78	1978.76	0.00	1047.02	405588	.7152
76	2.95	914	.455	.457	483.1	3193.00	2112.02	0.00	1086.98	406675	.7188
77	3.33	1103	.529	.511	619.3	3859.61	2318.74	0.00	1540.88	408216	.7231
78	4.57	1083	.372	.387	831.0	3885.92	2779.22	0.00	1106.70	409322	.7274
79	3.95	956	.359	.373	717.2	3347.71	2627.58	0.00	720.14	410042	.7312
80	4.35	1274	.405	.430	727.0	4457.55	2841.84	0.00	1615.71	411658	.7362
81	4.08	1145	.334	.409	681.9	4006.84	2731.42	0.00	1275.43	412934	.7407
82	3.42	1032	.422	.445	609.2	3611.79	2437.75	0.00	1174.04	414108	.7447
83	2.69	700	.370	.416	495.3	2471.79	1952.60	0.00	519.19	414627	.7475
84	3.60	770	.333	.332	574.5	2740.52	2291.87	0.00	448.65	415075	.7505
85	4.90	1286	.381	.402	774.9	4524.67	2912.25	0.00	1612.41	416688	.7556
86	4.63	1153	.354	.370	762.0	4059.76	2904.55	0.00	1155.22	417843	.7601
87	2.89	631	.329	.343	417.3	2244.40	1864.09	0.00	380.31	418223	.7626
88	3.97	1007	.339	.370	603.5	3523.73	2559.37	0.00	964.35	419188	.7666
89	3.69	985	.354	.397	716.8	3457.62	2669.00	0.00	788.62	419976	.7705
90	3.83	796	.281	.321	636.0	2806.82	2453.79	0.00	353.03	420329	.7736
91	4.00	747	.310	.283	508.5	2613.87	2479.02	0.00	134.86	420464	.7765
92	4.50	826	.274	.279	514.4	2905.69	2565.88	0.00	339.81	420804	.7798
93	2.80	488	.257	.254	355.4	1709.00	1868.67	0.00	-159.67	420644	.7817
94	3.85	747	.325	.311	606.0	2635.91	2310.80	0.00	325.11	420969	.7847
95	4.57	804	.285	.279	759.7	2825.58	2742.44	0.00	83.14	421053	.7878
96	3.03	540	.236	.270	476.0	1890.51	2066.09	0.00	-175.58	420877	.7899
97	3.58	651	.278	.280	533.6	2281.36	2225.69	0.00	55.67	420933	.7925
98	2.83	425	.223	.231	450.4	1492.76	1925.67	0.00	-432.90	420500	.7942
99	3.52	432	.178	.133	505.4	1516.79	2125.37	0.00	-608.58	419891	.7959
100	4.04	564	.202	.220	619.0	1987.95	2401.93	0.00	-413.98	419477	.7981
101	2.81	420	.226	.228	421.3	1477.37	1908.18	0.00	-430.81	419046	.7998
102	3.61	581	.316	.294	645.2	2384.90	2417.69	0.00	-32.79	419014	.8024
103	3.83	564	.239	.251	642.8	2253.06	2541.23	0.00	-288.17	418725	.8050
104	2.82	347	.192	.197	450.0	1223.33	1883.76	0.00	-660.42	418065	.8063
105	3.61	536	.277	.265	581.6	2227.94	2379.50	0.00	-151.56	417914	.8088
106	2.15	330	.233	.229	287.6	1154.10	1577.87	0.00	-423.77	417490	.8101
107	2.53	530	.236	.315	473.5	1857.61	1981.22	0.00	-123.61	417366	.8122
108	2.40	458	.238	.286	384.7	1602.02	1802.88	0.00	-200.87	417165	.8140
109	2.85	416	.208	.217	406.2	1466.78	1940.83	0.00	-474.05	416691	.8157
110	3.03	441	.224	.230	571.2	1544.58	2164.86	0.00	-620.28	416071	.8174
111	2.22	404	.256	.280	444.1	1433.36	1838.52	0.00	-405.16	415666	.8190
112	2.08	360	.253	.250	356.6	1261.66	1744.34	0.00	-482.69	415183	.8204

TABLE 7.6 (CONTINUED)

113	.94	402	.449	.528	320.3	1405.61	1430.79	0.00	-25.18	415158	.8220
114	1.33	424	.428	.482	346.5	1483.60	1529.87	0.00	-46.27	415112	.8237
115	.84	457	.635	.315	312.9	1599.58	1384.68	0.00	215.00	415327	.8255
116	.83	362	.504	.546	275.9	1266.08	1320.80	0.00	-54.72	415272	.8269
117	2.91	528	.250	.287	583.6	1859.15	2175.28	0.00	-316.13	414956	.8290
118	.92	448	.530	.700	311.6	1568.77	1425.60	0.00	143.17	415099	.8307
119	1.02	485	.642	.373	320.7	1696.98	1472.70	0.00	224.28	415323	.8326
120	.83	446	.451	.595	302.1	1555.69	1419.85	0.00	135.83	415459	.8344
121	.76	365	.430	.552	247.2	1278.06	1303.60	0.00	-25.54	415434	.8358

TABLE 7.6 (CONCLUDED)

DAILY SUMMARY

Mean utilization, hours	4.71
Standard deviation of utilization, hours	2.04
Load factor	.56
Total passengers carried	212,251.
Total direct operating cost, dollars	331,516.
Total indirect operating cost, dollars	86,815.
Total revenue, dollars	746,949.
Total profit, dollars	328,618.
Mean passenger wait time, minutes	13.88
Total demand	253,939.
Percent demand carried	83,58
Total revenue flights	4,672.
Total distance flown, miles	83,848.
Total revenue passenger miles flown	3,501,060.
Number ferry flights	173.
Total distance ferried, miles	5,496.
Profit per passenger, dollars	1.55
Fleet size	121
Total gates required	69

TABLE 7.7 - NETWORK MODEL RESULTS - DETROIT 95 SEAT AUGMENTOR WING STOL

FLIGHT STATISTICS

FLT NBR	HRS UTIL	PAX	WGT L.F.	L.F.	DISTANCE	REVENUE	DOC	IOC	PROFIT	CUM PRO	C.PCNT
1	8.13	3239	.570	.558	1298.5	11732.21	4265.33	0.00	7466.88	7467	.0128
2	8.41	3544	.616	.509	1315.9	13030.55	4412.81	0.00	8617.84	16085	.0271
3	7.34	3448	.613	.515	1035.5	12156.21	4050.40	0.00	8105.81	24191	.0407
4	7.64	3425	.573	.582	1363.9	12066.96	4204.92	0.00	7862.04	32053	.0542
5	6.71	3412	.624	.530	865.8	11941.42	3850.79	0.00	8090.64	40143	.0676
6	7.91	3365	.619	.526	1077.3	13568.57	4349.80	0.00	9218.77	49362	.0828
7	7.61	3536	.627	.538	1107.4	12827.53	4142.15	0.00	8685.38	58047	.0971
8	5.91	3238	.644	.541	1014.1	11512.92	3809.49	0.00	7803.43	65851	.1101
9	7.94	3303	.633	.532	1089.3	13678.66	4357.54	0.00	9321.12	75172	.1255
10	7.80	3510	.642	.526	1204.7	12441.34	4159.47	0.00	8281.87	83454	.1393
11	5.61	2795	.655	.554	735.5	9331.35	3259.78	0.00	6071.57	90125	.1503
12	5.14	3029	.629	.551	878.1	10653.69	3434.67	0.00	7159.01	97284	.1622
13	6.37	2314	.652	.530	1019.1	10304.11	3494.75	0.00	6809.36	104094	.1733
14	6.71	3351	.524	.520	1010.1	10923.34	3716.07	0.00	7207.27	111301	.1854
15	5.52	2581	.634	.517	789.1	9111.06	3210.24	0.00	5900.82	117202	.1955
16	6.23	2301	.603	.502	898.6	9808.29	3507.92	0.00	6300.37	123502	.2065
17	7.37	3420	.518	.501	1019.2	12120.72	4085.27	0.00	8035.44	131538	.2200
18	6.05	3340	.645	.553	844.0	10668.36	3472.71	0.00	7195.65	138733	.2320
19	7.35	3739	.531	.535	929.1	13332.41	4163.46	0.00	9158.95	147902	.2470
20	5.85	2722	.613	.510	828.4	9601.89	3371.84	0.00	6230.06	154132	.2577
21	4.64	2083	.589	.577	633.4	7364.01	2837.32	0.00	4526.69	158659	.2659
22	6.04	3015	.633	.548	838.8	10580.65	3469.33	0.00	7111.32	165770	.2778
23	5.67	2554	.505	.521	816.3	9329.78	3273.17	0.00	6056.51	171827	.2882
24	6.04	2380	.615	.527	811.1	10432.09	3496.91	0.00	6935.18	178762	.3000
25	5.41	2456	.558	.574	720.5	8647.72	3211.38	0.00	5436.33	184198	.3096
26	4.60	2324	.627	.544	621.9	8238.25	2829.93	0.00	5408.32	189607	.3188
27	5.55	2537	.592	.503	743.3	9299.89	3271.55	0.00	6028.34	195635	.3292
28	5.31	2379	.537	.582	739.6	8358.37	3132.88	0.00	5225.49	200861	.3385
29	3.80	1531	.558	.554	524.2	5707.91	2448.96	0.00	3258.95	204120	.3449
30	4.71	2158	.551	.595	632.0	7604.55	2881.81	0.00	4722.75	208842	.3535
31	5.05	2357	.554	.591	675.9	8273.09	3047.01	0.00	5232.08	214074	.3628
32	5.01	2597	.625	.544	687.8	8784.59	3008.54	0.00	5775.96	219850	.3726
33	5.44	2591	.575	.593	703.3	9088.69	3245.72	0.00	5842.97	225693	.3828
34	6.33	3168	.603	.518	806.0	11089.02	3675.33	0.00	7413.69	233107	.3953
35	5.83	2735	.593	.500	791.5	9654.39	3393.44	0.00	6260.95	239368	.4061
36	5.05	2538	.594	.507	621.0	8833.28	3101.83	0.00	5781.46	245149	.4161
37	4.39	2387	.595	.594	572.1	7306.02	2752.38	0.00	4553.64	249703	.4243
38	5.44	2576	.618	.526	730.8	9411.33	3218.03	0.00	6193.30	255896	.4348
39	4.39	1908	.541	.574	523.6	6721.49	2694.75	0.00	4026.74	259923	.4424
40	5.75	2710	.582	.594	760.7	9485.49	3373.55	0.00	6111.93	266035	.4530
41	4.83	2257	.591	.531	649.3	7863.19	2938.81	0.00	4924.39	270959	.4619
42	4.93	2335	.585	.599	656.0	8172.02	2988.13	0.00	5183.88	276143	.4711
43	5.50	2355	.547	.563	782.3	8314.19	3205.84	0.00	5108.35	281252	.4803
44	5.15	2433	.553	.582	651.8	8543.35	3121.73	0.00	5421.63	286673	.4899
45	5.11	2571	.627	.539	640.1	9349.85	3114.14	0.00	6235.71	292909	.5005
46	4.57	2229	.593	.502	579.1	7801.21	2847.72	0.00	4953.49	297862	.5092
47	5.07	2153	.526	.542	679.9	7593.12	3048.89	0.00	4544.24	302407	.5177
48	4.64	2295	.601	.520	607.7	8034.04	2866.14	0.00	5167.90	307575	.5268
49	4.93	2131	.537	.547	658.2	7456.89	2989.56	0.00	4467.33	312042	.5352
50	4.87	2167	.552	.570	663.8	7623.54	2947.78	0.00	4675.75	316718	.5437
51	5.05	2371	.544	.567	618.8	8323.14	3100.42	0.00	5222.72	321940	.5530
52	4.99	2187	.532	.551	590.7	7687.21	3004.09	0.00	4683.14	326624	.5617
53	3.72	1445	.475	.431	493.1	5062.01	2428.95	0.00	2633.07	329257	.5674
54	4.35	1320	.508	.546	560.9	5736.26	2745.15	0.00	3991.10	333248	.5749
55	3.75	1546	.497	.525	505.9	5418.86	2437.18	0.00	2981.68	336229	.5810

TABLE 7.7 (CONTINUED)

56	3.63	1575	.519	.335	490.1	5512.90	2420.52	0.00	3092.39	339322	.5872
57	5.59	1360	.427	.449	754.6	6308.28	3278.93	0.00	3629.46	342351	.5949
58	2.65	981	.446	.469	353.1	3445.80	1929.87	0.00	1516.92	344468	.5988
59	5.01	1748	.448	.449	656.5	6234.34	3037.86	0.00	3196.48	347565	.6057
60	3.51	1518	.535	.533	544.9	5313.12	2553.13	0.00	2759.99	350425	.6116
61	3.65	1290	.448	.468	525.2	4544.86	2358.76	0.00	2186.10	352511	.6157
62	2.03	921	.519	.540	363.5	2872.25	1754.91	0.00	1117.34	353728	.6200
63	4.49	1511	.435	.458	792.9	5401.37	2894.70	0.00	2506.57	356235	.6259
64	4.73	1527	.415	.439	795.4	5708.49	3169.51	0.00	2538.98	358774	.6323
65	3.03	1139	.445	.430	441.3	4013.43	2168.44	0.00	1844.98	360619	.6368
66	2.35	1106	.543	.582	403.6	3871.15	2007.89	0.00	1863.25	362482	.6412
67	3.67	1289	.434	.452	570.1	4532.59	2724.59	0.00	1808.01	364290	.6452
68	2.93	1332	.496	.472	491.3	3621.18	2200.66	0.00	1420.52	365710	.6503
69	3.05	1136	.478	.478	520.1	3975.58	2310.07	0.00	1665.51	367376	.6548
70	5.23	1550	.404	.413	741.0	5787.76	3088.39	0.00	2699.37	370075	.6613
71	4.43	1426	.403	.406	717.8	5007.75	3027.95	0.00	1979.79	372055	.6669
72	3.21	1253	.454	.493	583.7	4421.79	2532.73	0.00	1889.06	373344	.6719
73	5.02	1921	.424	.446	800.5	6373.01	3399.27	0.00	2973.74	376318	.6790
74	4.74	1527	.394	.423	906.4	5414.05	3130.55	0.00	2283.50	379201	.6850
75	4.19	1391	.399	.418	719.3	4870.56	2933.53	0.00	1937.03	381088	.6905
76	4.60	1594	.338	.442	753.5	5579.89	3096.43	0.00	2483.46	383572	.6968
77	4.93	1470	.353	.377	775.1	5145.54	3201.23	0.00	1944.31	385516	.7026
78	4.40	1111	.306	.316	576.6	3886.96	2755.29	0.00	1131.67	386648	.7070
79	4.53	1442	.358	.399	763.2	5047.93	3102.69	0.00	1945.24	388593	.7126
80	5.53	1367	.330	.367	929.5	5301.68	3373.26	0.00	1928.42	390522	.7188
81	4.85	1403	.344	.359	754.2	4911.30	3142.29	0.00	1769.01	392291	.7243
82	5.09	1342	.316	.336	754.9	4706.95	3188.14	0.00	1518.81	393809	.7296
83	4.65	1182	.319	.319	515.1	4135.82	2870.95	0.00	1264.87	395074	.7343
84	4.41	1060	.285	.301	612.0	3709.04	2823.53	0.00	885.51	395960	.7384
85	5.30	1221	.291	.292	705.9	4275.72	3157.25	0.00	1118.47	397078	.7433
86	3.69	703	.259	.255	535.3	2492.26	2365.28	0.00	126.98	397205	.7460
87	3.81	301	.252	.264	531.6	2813.38	2544.58	0.00	268.80	397474	.7492
88	4.22	1020	.300	.307	566.7	3576.38	2658.03	0.00	918.35	398392	.7532
89	2.80	507	.298	.278	413.0	2128.72	2059.34	0.00	69.38	398462	.7556
90	3.82	920	.288	.288	527.6	2920.50	2561.06	0.00	359.45	398821	.7588
91	4.04	830	.252	.265	557.2	2925.29	2561.09	0.00	364.19	399185	.7621
92	3.51	733	.291	.256	541.0	2565.02	2459.83	0.00	105.19	399291	.7650
93	3.29	571	.210	.215	418.6	1998.26	2244.63	0.00	-246.37	399044	.7672
94	4.52	939	.254	.257	585.9	3293.70	2916.56	0.00	377.14	399421	.7709
95	3.65	582	.244	.248	527.4	2386.82	2360.17	0.00	26.65	399448	.7736
96	4.25	855	.257	.257	645.4	2991.96	2799.66	0.00	192.31	399640	.7770
97	3.47	775	.320	.291	584.9	2711.12	2488.11	0.00	223.01	399863	.7800
98	2.43	709	.332	.325	460.4	2486.64	2135.34	0.00	351.30	400215	.7828
99	2.37	549	.286	.273	345.7	1907.03	1970.53	0.00	-63.50	400151	.7850
100	3.25	702	.294	.274	532.2	2457.20	2408.73	0.00	48.47	400200	.7877
101	2.15	458	.272	.258	331.3	1603.58	1902.66	0.00	-299.08	399901	.7895
102	2.17	404	.204	.236	389.3	1414.52	1907.83	0.00	-493.31	399407	.7911
103	2.52	522	.252	.252	401.3	1827.00	2006.39	0.00	-179.40	399228	.7932
104	1.77	492	.358	.345	362.4	1720.33	1799.59	0.00	-79.26	399149	.7951
105	2.50	446	.226	.234	455.5	1559.42	2041.34	0.00	-481.92	398667	[illegible]
106	2.65	541	.250	.271	491.3	1914.89	2103.39	0.00	-188.50	398478	.7990
107	1.25	394	.301	.415	345.4	1380.78	1606.99	0.00	-226.21	398252	.8005
108	2.95	385	.153	.152	385.3	1345.86	2086.92	0.00	-741.07	397511	.8021
109	.94	382	.416	.503	251.4	1338.66	1410.11	0.00	-71.45	397439	.8036
110	1.13	566	.559	.596	334.2	1980.82	1645.17	0.00	335.65	397775	.8058
111	2.51	558	.312	.234	458.3	1965.02	2043.13	0.00	-78.11	397697	.8080
112	2.77	419	.193	.192	402.9	1466.93	2052.81	0.00	-585.88	397111	.8096

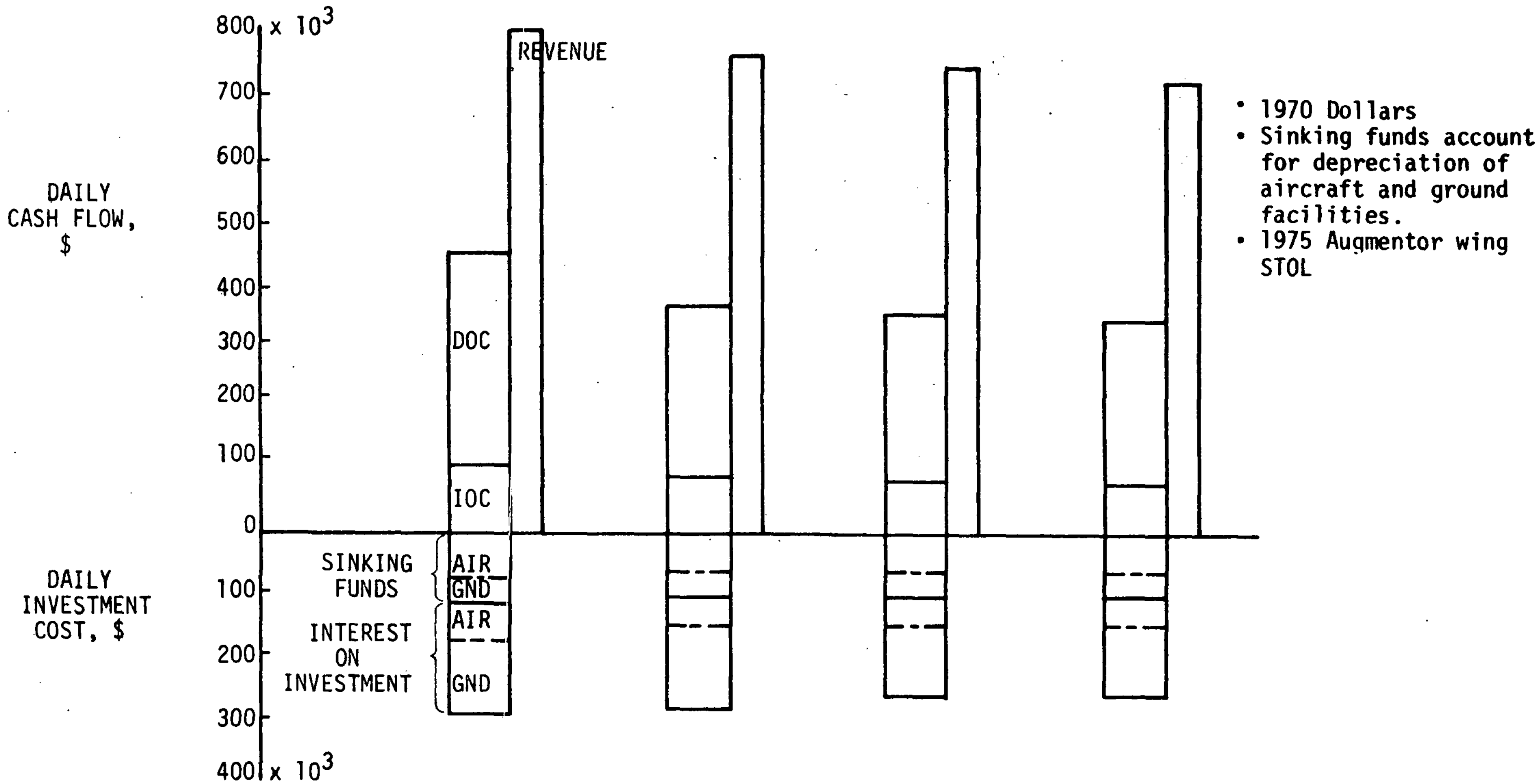
TABLE 7.7 (CONTINUED)

113	.81	.430	.511	.547	266.2	1505.22	1419.68	0.30	85.54	397197	.8113
114	.80	.440	.504	.562	263.6	1541.56	1418.01	0.30	123.55	397320	.8131
115	.77	.469	.434	.705	251.4	1639.91	1410.14	0.30	229.77	397550	.8149

TABLE 7.7 (CONCLUDED)

DAILY SUMMARY

Mean utilization, hours	4.54
Standard deviation of utilization, hours	1.69
Load factor	.50
Total passengers carried	206,938.
Total direct operating cost, dollars	330,768.
Total indirect operating cost, dollars	83,959.
Total revenue, dollars	728,318.
Total profit, dollars	313,591.
Mean passenger wait time, minutes	14.08
Total demand	253,939.
Percent demand carried	81.49
Total revenue flights	4,274.
Total distance flown, miles	76,404.
Total revenue passenger miles flown	3,419,485.
Number ferry flights	144.
Total distance ferried, miles	4,483.
Profit per passenger, dollars	1.51
Fleet size	115.
Total gates required	64.



AIRCRAFT SIZE (SEATS)	40	60	80	95
PASSENGERS CARRIED DAILY	228,877	218,257	212,251	206,938
NET PROFIT PER DAY	$65,000	$120,700	$140,000	$126,200
NET PROFIT PER PASSENGER	$ .28	$ .55	$ .66	$ .61

FIGURE 7.5: ECONOMIC COMPARISON, DETROIT (1965)

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5. Hoerl, A. E., and Kennard, R. W., "Ridge Regression: Biased Estimation for Nonorthogonal Problems", Technometrics, Volume 12, No. 1, February 1970 pp 55-67.

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APPENDIX A

AN ELEMENTARY DEMAND MODEL INCLUDING COMPARISON TO NORTHEAST CORRIDOR STUDY

By Robert V. Panos

INTRODUCTION

One of the first tasks performed in this study was the construction of an elementary demand model. The primary objective was to satisfy the requirement for an elementary comparison with the Northeast Corridor Demand model. In addition, this task provided a chance to gain familiarity with the Bay Area data base and to investigate differing approaches to demand modeling.

Data available for this task consisted of (1) a set of data for population, employment, housing, and land use variables, obtained from the Bay Area Transportation Study Commission (BATSC)*, and (2) actual person-trip data for 1965, also obtained by BATSC. The latter data set consists of production-attraction trip tables, which mean that the trips are nondirectional and should be interpreted as trip interchanges between zones.

The person-trip data is given in terms of 291 internal map zones; distances between the population centroids of these zones were estimated. Congestion was introduced in terms of natural barriers (e.g., bridges) and the number of centroids between zones of interest.

The elementary model, as finally developed, depends on population, employment, congestion and distance. Employment as used here is the sum of three employment variables defined in the BATSC report: Employed resident, basic employment, and population-serving employment.

This model does a creditable job when used to predict Northeast Corridor traffic. It out performs the NECTP-230 model on this data set, having a larger number of city-pairs for which better estimates are obtained and also having a smaller total sum of absolute differences from the actual traffic.

Model extension through inclusion of additional variables, such as trip-time, trip-cost and attitudinal variables, would be straightforward. However, there are two difficulties which must be overcome before this model could serve as a basis for a generalized demand and mode-split model. These are:

* BATSC Technical Report 226, BATSC Controlled Trends Zonal Forecasts, 1965-1980-1990. Berkeley: Bay Area Transportation Study Commission May 1, 1969.

1) The approach to congestion is somewhat subjective, particularly with respect to natural or man-made barriers. A unique, objective way of handling congestion is required.

2) A constant in the model is somewhat dependent on distance. If the magnitude of the distances involved changes radically (as in going from the Bay Area to the Northeast Corridor), then the constant must be re-estimated or the distances must be scaled. Further work is required to determine the optimal method of scaling.

Because of these difficulties, the approach to a generalized demand and modal-split model has taken a different direction. The elementary model may still serve a useful purpose in situations where mode-split is not required. It may also suggest directions for further research.

GENERAL APPROACH

The intent of this task was to develop an elementary demand model which could be used to forecast total traffic and interzonal traffic for relatively large urban areas. Specifically, forecasts of traffic in the Bay Area and in the Northeast Corridor were required.

The model for predicting travel consists of two distinct parts: (1) estimation of the total traffic leaving each zone and (2) assignment of this traffic to each of the other zones. It seemed useful to split up the problem in this fashion, since other methods may be available for estimating total traffic leaving a zone. For example, a simple count of cars and the number of passengers on public transportation could be made. Thus, estimates of current total traffic could be validated easily. However, only a survey could determine the destinations of travellers.

In this model, it is assumed that all travel is symmetric, i.e., the number of trips from zone i to zone j is equal to the number of trips from j to i. Thus, cyclic travel is ignored (from i to j to k to i).

The two steps in the analysis are approached differently. For step one, the best independent variable, in a statistical sense, is used to predict the total travel leaving a zone. The best variable, as determined from the available data, is total employment, defined as the sum of employed residents, basic employment, and population-serving employment.

For step two, congestion, population, and distance were picked as the variables to be used to predict zonal traffic. Various functions of these variables were investigated to determine the best functional relationship for prediction purposes.

The following steps outline the technique. Each step is described below.

1) Zone location
2) Distance estimation
3) Congestion estimation
4) Estimation of total zonal traffic (model definition, step one)
5) Assignment of traffic to other superzones (model definition, step two)
6) Estimation of model coefficient
7) Display of model output
   a. Total demand estimated
   b. Total demand known
8) Comparison to NECTP-230

DESCRIPTION

1) Zone location

The 291 subzones outlined in the BATSC Report were grouped into 30 superzones. Table 1 shows which subzone went into each superzone.

The 30 superzones were divided in such a way that they were similar to both the BATSC superdistricts and the superzones used in NASA CR-114347.* While the zones have these characteristics, they also have other constraints such as:

a. Reasonable in population size,
b. Reasonable in traffic demand,
c. Geographically sound, and
d. Logical with respect to man-made boundaries.

2) Distance estimation

The distances used were highway distances from the estimated population centroids of each superzone. The centroids were

*NASA CR-114347, Study of Aircraft in Intraurban Transportation Systems San Francisco Bay Area. Prepared under contract NAS2-5969 by The Boeing Company, Seattle, Washington, September 1971.

TABLE 1
SUBZONE ASSIGNMENT TO 30 SUPERZONES

SUPERZONE	ZONES																			
1	2	3	4	5	6	7	8	39	40											
2	21	22	23	24	25	26	27	28	29	30	31	32								
3	1	9	10	11	12	13	14	15	16											
4	17	18	19	20	33	34	35	36	37	38										
5	58	59	60	61	62	63	65	66	83	90	91									
6	64	67	68	69	70	71	72	73	74	75	76	77	78	79	89					
7	80	81	82	84	85	86	87	88	216	217	218	219								
8	201	202	207	208	209	210	211	212	213	214	215									
9	175	176	177	178	179	184	185	186	187	188	189	194	195	196	197	198	199	200	203	204
	205																			
10	166	167	168	180	181	182	183	190	191	192	193	206								
11	169	170	171	172	173	174	220	221												
12	161	162	163	164	165	222														
13	223	224	225	226	252															
14	227	228	229	230	231	232	233	234	235	236	237									
15	238	239	240	241	242	243	244	245	246	247	248									
16	249	250	251	253	254	255	256	257	258	259	260									
17	261	262	263	264	265	267	268	269	270	271	275	276	277	278	279	280				
18	266	272	273	274	281	282	283	284	285	286	287	288	289	290	291					
19	126	127	128	129	130	131	132	133	159	160										
20	134	135	136	140																
21	137	138	139	141	142	143	144	145	146	147	148	149	157	158						
22	150	151	152	153	154	155	156													
23	111	112	113	114	115	124	125													
24	117	118	119	120	121	122	123													
25	102	103	104	109	110	116														
26	105	106	107	108																
27	97	98	99																	
28	93	94	95	96																
29	50	51	52	53	54	92	100	101												
30	41	42	43	44	45	46	47	48	49	55	56	57								

not calculated but were estimated after investigating the populations of all 291 subzones.

Figure 1 shows where the centroids are located. Highway distances were used so that if ground rapid transit or air travel could be made available, the distances would change and the model would reflect this travel pattern change. Table 2 shows the 30 by 30 matrix with the highway distances.

3) Congestion estimation

Congestion is the number of intervening centroids between any two zones of interest. Estimation of congestion is based on travel by auto; Figure 1 also shows the choices of congestion nodes. Table 3 is a 30 by 30 matrix displaying the values for congestion between any two zones.

While it is true that this table is not unique, the comparison with the Northeast Corridor data strengthens the congestion concept. Time did not permit the opportunity to find a unique method, and it is suggested that such a method be found so all subjectivity would be removed. One idea might be to use a circular grid and count centroids within a sector.

In addition to congestion because of intervening zones, values were assigned to natural barriers. For the Bay Area, the only natural barriers considered of importance were bridges. They were assigned a value equivalent to two congestion centroids.

4) Estimation of total zonal traffic (model definition, step one) BATSC "Controlled Trands" zonal forecasts were used as the source document for the candidate independent variables. An examination of the independent variables indicated that some of the variables (population, dwelling units) need not be investigated further.

Initial plots of the other candidate variables indicated that there was a linear relationship on the logarithms of the variables. This transformation of the data gave a linear fit that was better than that obtained if no transformation was attempted or if only the independent variables were transformed. The purpose of trying to get a linear fit is because standard statistical techniques, such as linear regression, can be used to get the predictive equation.

The candidate independent variables (employment and land measurement) and the total zonal demand (dependent variable) were investigated using stepwise regression. The purpose

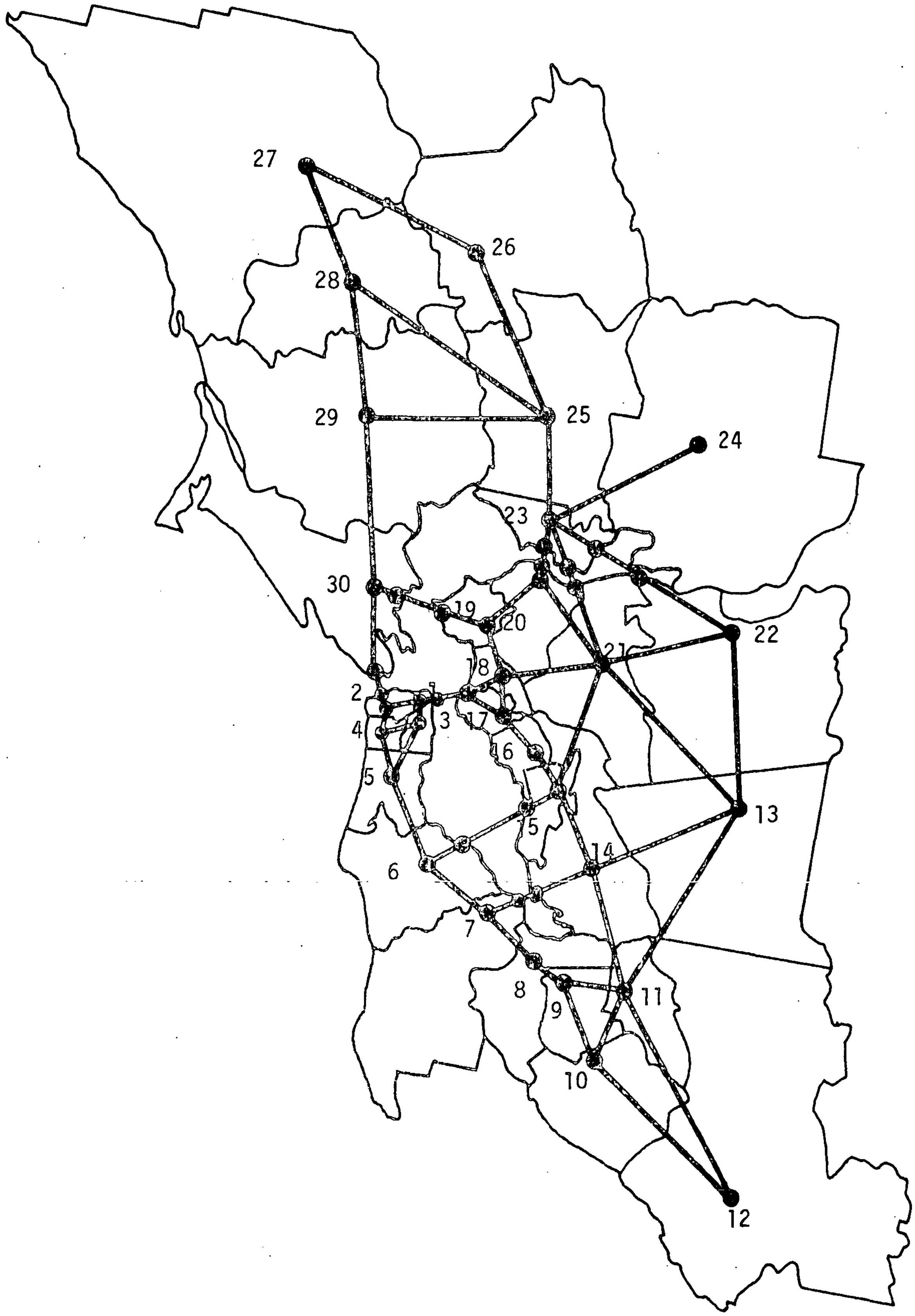

FIGURE 1
CONGESTION CENTERS (OR NODES) FOR THE
SAN FRANCISCO BAY AREA SUPERZONES

TABLE 2
HIGHWAY DISTANCES BETWEEN BAY AREA SUPERZONE CENTROIDS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1																													
2	6.5																												
3	6.7	11.0																											
4	5.5	3.7	7.9																										
5	12.5	11.7	10.5	7.0																									
6	26.6	25.9	19.9	21.2	14.2																								
7	35.8	35.1	29.1	33.4	23.4	11.4																							
8	45.1	44.4	38.4	39.7	32.7	20.7	13.9																						
9	53.6	52.9	46.9	48.2	41.2	29.2	22.4	15.3																					
10	65.1	66.0	60.0	61.3	54.3	42.3	35.5	28.4	16.5																				
11	53.3	52.6	46.4	47.9	40.9	29.9	22.1	15.0	7.5	13.8																			
12	80.3	79.6	73.5	74.9	67.9	55.9	49.1	42.0	34.5	24.8	29.0																		
13	[illegible]	50.4	46.2	52.6	53.6	41.0	34.2	43.5	39.0	51.5	38.7	65.7																	
14	40.1	43.4	44.5	45.8	38.8	23.8	17.0	26.3	21.8	34.3	21.5	43.5	7.2																
15	26.3	29.6	25.4	31.8	32.9	25.2	27.0	36.3	35.0	46.8	33.0	61.0	1.7	19.1															
16	20.5	24.1	19.9	26.3	30.4	29.1	30.9	40.2	38.9	51.2	37.4	65.4	[illegible]	22.5	8.4														
17	15.0	19.3	14.1	20.5	24.6	13.5	35.3	44.6	43.3	55.6	41.6	69.8	8.0	26.9	14.2	7.8													
18	13.5	16.8	12.6	19.0	23.1	32.5	41.0	50.3	49.0	61.3	48.5	75.5	3.7	32.6	19.9	13.5	7.7												
19	17.7	21.0	16.8	23.2	27.3	36.7	45.2	54.5	53.2	65.6	52.7	79.7	7.9	36.8	24.1	17.7	11.3	7.6											
20	29.9	33.2	29.0	35.4	39.5	48.9	57.4	66.7	65.4	77.7	64.9	91.9	5.1	49.0	36.3	29.9	24.1	19.8	12.8										
21	33.9	34.2	30.0	36.4	40.5	49.9	59.1	63.3	58.8	77.1	63.3	91.3	0.1	48.4	30.0	29.3	23.5	22.0	24.5	19.0									
22	41.6	45.1	40.9	47.3	51.4	60.8	70.0	74.2	69.7	89.6	75.8	103.8	2.6	50.3	42.5	41.8	36.0	34.5	32.9	27.3	12.5								
23	33.8	37.1	32.7	39.3	43.4	52.8	61.3	70.6	69.3	81.5	68.7	95.7	2.9	52.8	40.1	33.7	27.9	23.6	16.6	[illegible]	22.9	[illegible]							
24	57.8	55.1	51.9	58.3	62.4	71.2	80.3	89.6	83.1	100.5	87.7	114.7	1.0	71.3	59.1	52.7	46.9	42.6	35.4	22.6	30.2	39.2	19.0						
25	47.7	52.0	47.8	54.2	58.3	67.7	76.2	85.5	84.2	96.4	93.6	108.9	6.1	67.7	55.0	48.6	42.8	36.8	31.5	22.3	37.7	46.0	19.1	24.3					
26	63.2	66.5	62.3	69.7	72.8	82.2	80.7	100.0	98.7	110.9	98.1	123.4	[illegible]	82.2	69.5	63.1	57.3	53.0	46.0	36.8	52.7	63.0	33.6	39.3	18.5				
27	71.7	69.2	76.2	72.9	79.9	94.1	103.3	112.6	121.1	116.3	103.5	142.2	10.0	104.0	88.3	93.9	78.1	73.8	65.8	72.3	97.7	95.5	67.1	74.8	52.0	35.5			
28	54.0	51.5	58.5	55.2	62.2	76.4	85.6	94.9	103.4	134.0	121.2	129.5	[illegible]	86.1	71.2	66.2	50.4	56.1	48.1	37.7	75.7	81.7	57.1	62.8	40.0	22.5	17.7		
29	40.5	38.0	45.0	41.7	48.7	62.9	72.1	81.4	89.9	102.8	90.0	116.0	8.2	71.9	57.7	52.7	46.9	42.6	34.6	33.2	59.9	[illegible]	41.3	57.4	48.7	43.0	34.2	16.5	
30	14.7	12.2	19.2	15.9	29.9	32.1	46.3	55.6	64.1	77.0	64.2	90.2	8.4	[illegible]	37.3	32.3	26.5	22.2	15.2	27.4	39.2	47.5	31.2	50.2	45.8	65.0	59.2	41.5	[illegible]

TABLE 3
CONGESTION CENTROIDS BETWEEN BAY AREA SUPERZONES

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1																														
2	2																													
3	2	3																												
4	3	2	2																											
5	3	3	2	2																										
6	4	4	3	3	2																									
7	5	5	4	4	3	2																								
8	6	6	5	5	4	3	2																							
9	7	7	6	6	5	4	3	2																						
10	8	8	7	7	6	5	4	3	2																					
11	8	8	7	7	6	5	4	3	2	2																				
12	9	9	8	8	7	6	5	4	3	2	2																			
13	6	7	7	8	7	6	5	4	3	3	2	3																		
14	7	8	8	7	6	5	4	5	3	3	2	3	2																	
15	6	7	7	6	5	4	5	6	4	4	3	4	3	2																
16	5	6	6	7	6	5	6	7	5	5	4	5	4	3	2															
17	4	5	5	6	6	6	7	8	6	6	5	6	5	4	3	2														
18	4	5	5	6	6	7	8	9	7	7	6	7	3	5	4	3	2													
19	5	6	6	7	7	8	9	10	8	8	7	8	4	6	5	4	3	2												
20	6	7	7	8	8	6	7	8	6	6	5	6	3	4	3	5	4	3	2											
21	5	6	6	7	7	5	6	7	5	5	4	5	2	3	2	3	3	2	3	2										
22	6	7	7	8	8	6	6	7	4	4	3	4	2	3	3	4	4	3	4	3	2									
23	9	10	10	11	11	8	9	10	8	8	7	8	5	6	5	8	7	6	5	4	4	4								
24	10	11	11	12	12	9	10	11	9	9	8	9	6	7	6	9	8	7	6	5	5	5	2							
25	10	6	11	7	8	9	10	11	9	9	8	9	6	7	6	9	8	7	6	5	5	5	2	3						
26	8	7	9	8	9	10	11	12	10	10	9	10	7	8	7	10	9	8	7	6	6	6	3	4	2					
27	8	7	9	8	9	10	11	12	13	14	13	14	8	9	8	10	9	8	7	7	7	7	4	5	3	2				
28	7	6	8	7	8	9	10	11	12	13	12	13	7	8	7	9	8	7	6	6	6	6	3	4	2	3	2			
29	6	5	7	6	7	8	9	10	11	12	11	12	7	9	9	8	7	6	5	6	6	6	3	4	2	3	3	2		
30	5	4	6	5	6	7	8	9	10	11	10	11	7	9	8	7	6	5	4	5	6	7	8	9	3	4	4	3	2	

of stepwise regression is to provide a basis to eliminate variables which will not contribute significantly in the predictive equation.

Only the employment variables were used in the predictive equation since the additional improvement did not warrant the use of more than one independent variable. Table 4 shows the candidate variables, and Figure 2 shows the linear fit to the data using only the employment variable.

The employment variable as used in this predictive equation is the sum of three employment variables as defined in the BATSC forecast. These are:

Employed resident	Those members of a household reporting full-time or part-time employment.
Basic employment	The total number of jobs in industries classified as "basic" at place of work constitutes basic employment.
Population-serving employment	The total number of jobs in industries classified as "population-serving" at place of work constitutes population-serving employment.

Table 5 displays the actual and estimated total demand values and Attachment 1 shows the results of the stepwise regression. Examination of Attachment 1 shows that the multiple R is 0.93 when only employment is used and that the multiple R increases to 0.94 when all four variables are used. Because of this small increase only employment was used. The results are shown in Table 5 and Figure 2.

Step one of the stepwise regression gives the constant and coefficient for the expression reflecting total demand. The equation is

$$\text{Log (Total Demand)} = -1.595 + 1.309 \text{ Log (Employment)} \qquad (1)$$

where employment is the sum of employed residents of the zone as defined above.

5) Assignment of traffic to other superzones (model definition, step two)

The approach which is used to assign traffic to other superzones uses the total traffic leaving a zone as a control.

TABLE 4
DATA FOR CANDIDATE VARIABLES FOR TOTAL ZONAL TRAFFIC MODEL

SUPERZONE	TOTAL DEMAND	EMPLOYED RES. +TOTAL EMPL.	BASIC	A C R E S POP.SERV.	RESID.
1	330503	308662	487	503	639
2	221628	172781	204	615	3291
3	203475	183647	2930	614	2718
4	189486	144543	113	679	6852
5	164905	170832	4349	907	12992
6	128321	160734	1258	1475	17185
7	136242	129350	2647	738	18869
8	181381	132414	3386	1200	13683
9	319508	261294	3599	1749	19334
10	161839	92945	1667	660	13700
11	84457	53995	1114	339	6446
12	8098	22118	4056	192	4386
13	15994	34234	798	151	4202
14	78324	83007	2328	578	11579
15	141408	139111	1098	1424	12337
16	191749	125859	2169	903	9576
17	292651	265870	5358	1655	9045
18	195082	165467	2359	799	9693
19	102428	115750	2160	1074	10150
20	48927	26576	868	329	4803
21	82471	124402	2596	1530	34498
22	19786	48504	1255	441	5805
23	30464	60509	2244	219	3845
24	8567	39753	5032	177	2230
25	18380	39368	1302	346	3561
26	4388	9304	74	73	1171
27	23387	23645	497	249	1464
28	30487	57611	867	717	3915
29	38335	46094	538	308	4303
30	57149	97726	2626	664	10276

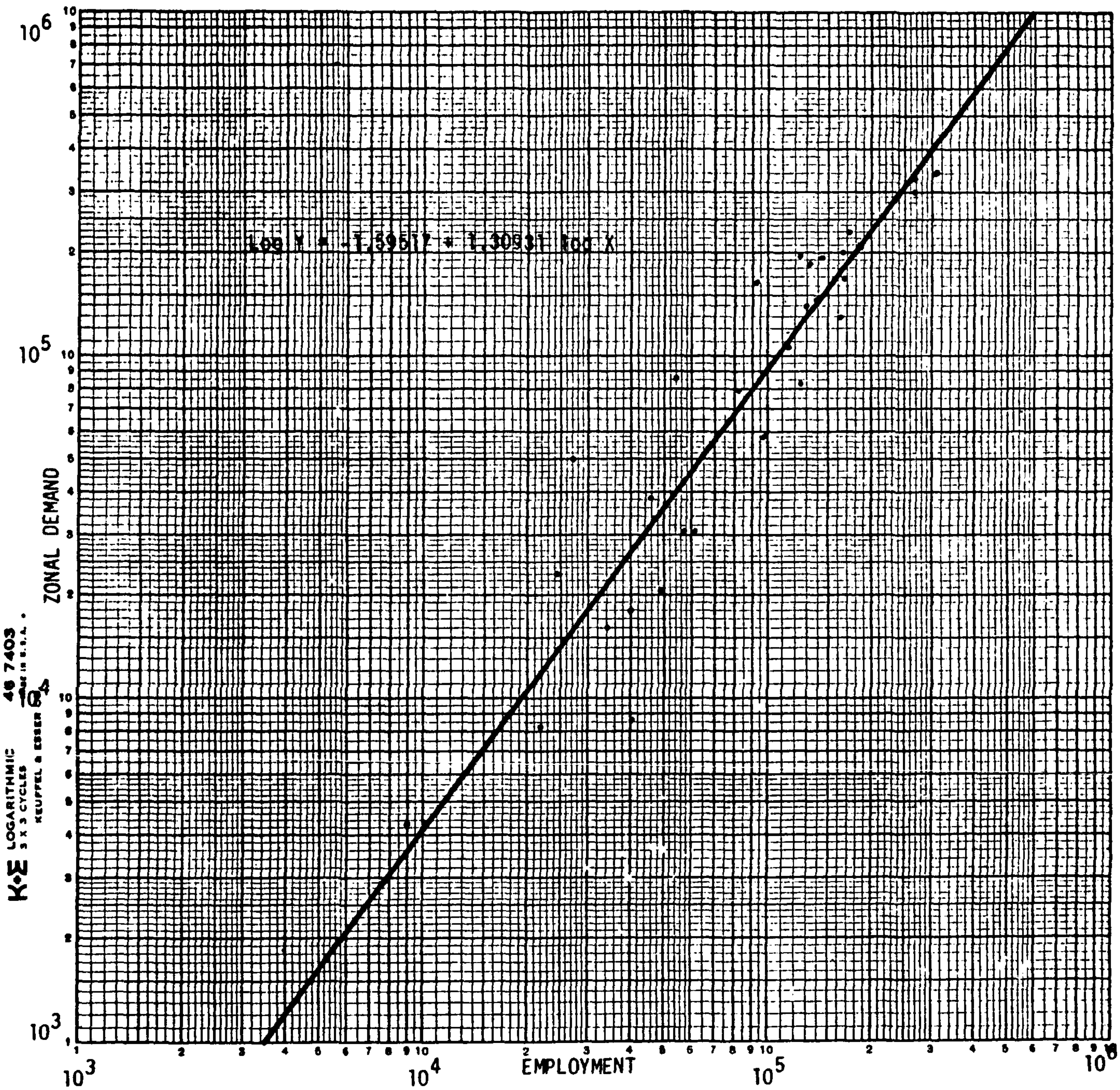

FIGURE 2
RELATIONSHIP BETWEEN EMPLOYMENT AND ZONAL DEMAND
FOR 30 SUPERZONES

TABLE 5
ACTUAL AND ESTIMATED TOTAL ZONAL TRAVEL
FOR THE SAN FRANCISCO BAY AREA

ZONE	ACTUAL	ESTIMATED
1	330503.0	391079.6
2	221628.0	182951.5
3	203475.0	198160.3
4	189486.0	144832.4
5	164905.0	180254.1
6	128321.0	166432.8
7	136242.0	125232.5
8	181381.0	129130.6
9	319508.0	314435.6
10	161839.0	81241.5
11	84457.0	39897.7
12	8098.0	12400.8
13	15994.0	21970.5
14	78324.0	70061.0
15	141408.0	137747.8
16	191749.0	120825.7
17	292651.0	321665.0
18	195082.0	172878.5
19	102428.0	108280.1
20	48927.0	15771.0
21	82471.0	118997.7
22	19786.0	34670.9
23	30464.0	46314.3
24	8567.0	26719.7
25	18380.0	26381.4
26	4388.0	3990.7
27	23387.0	13533.5
28	30487.0	43431.8
29	38335.0	32432.9
30	57149.0	86756.1

This total traffic is either known or estimated from equation (1). The model predicts a relative demand which must be adjusted using the total demand to get an actual demand.

The only reasonable way to estimate a relative demand when population, congestion and distance are the variables would be to have traffic increase as population increases and for the traffic to increase as congestion and/or distance decreases.

Different forms of the model were examined by plotting and it was found that the model should be of the form

$$RD_{ij} = \frac{P_j}{N_{ij} \exp(\alpha D_{ij})} \qquad i \neq j \qquad (2)$$

where

RD_{ij} - is the relative demand of the total traffic from one zone to all the other zones. For example, this would be the portion of the total traffic leaving zone one that went to zone two.

P_j - is the population of the destination zone. For the example above, P_j would be the population of zone two.

N_{ij} - is the estimate of congestion centers between the two zones. Again, for the example, it would be the congestion between zones one and two.

D_{ij} - is the distance between the zones; as before it would be between zones one and two.

α - is an estimable coefficient.

Once all the relative demands have been estimated, there will be 870 for the 30 by 30 matrix. They are normalized for the actual demand, (AD), between zones. The equation used to normalize the relative demand is

$$AD_{ij} = \frac{T_i \; RD_{ij}}{RD_i} \qquad i \neq j \qquad (3)$$

where

T_i - is the total traffic leaving a zone. This value is known or estimated from equation (1).

RD_{ij} - is the relative demand calculated from equation (2).

RD_i - is the sum of all relative demands for any zone as calculated from equation (2).

6. Estimation of model coefficient

The reason the model is of the form as expressed in equation (2) is because

$$\frac{RD_{ij}N_{ij}}{P_j} = D_{ij} \qquad (4)$$

has a linear relationship when plotted on semi-log paper when $RD_{ij}\ N_{ij}\ /\ P_j$ is plotted on the log scale.

The plots of equation (4) indicate that the slopes of the relationships are about 0.05. These slopes are the coefficients (α) needed in equation (2). It would be desirable to find a best α to use for the entire Bay Area. This was done in the following way.

The technique to find the best single α for all 30 zones was one that minimized the sum of all the absolute differences of actual and estimated travel over the 870 paths. The reason for choosing the sum of absolute differences as a measure of quality is because the Northeast Corridor Study (NECTP-230) uses this technique, and a later comparison will be made with that document.

Another approach which could be used to find a best α would be analysis of covariance; the best slope would be the common α. This technique was tried and was discarded because the sum of the absolute differences was larger than when this sum was minimized as outlined above.

Figures 3 and 4 show the different values of α for both known and estimated travel out of a zone. It is interesting that the values are relatively close (0.050 when total travel is known and 0.056 when travel is estimated). Attachments 2 and 3 are the printouts for various α's and the summary table of absolute differences. These summary tables show that the increase in the absolute differences if different α's were used (that is .05 instead of .056, or .056 instead of .05) is less than one per cent.

7) Display of model output

A) Attachment 4 contains the traffic demand for the 870 different zonal paths when the total traffic from a zone is estimated. The demand matrix has been made symmetric by adding the two-way travel between two zones and then dividing by two.

For each of the 870 pairs, the following information is listed:

a. Actual Travel - This is the actual travel between the two zones and is from the 1965 base data for the Bay Area.

b. Estimated Travel - This is the travel between the two zones estimated from equations (2) and (3).

c. Absolute Difference - This is the absolute value of actual travel minus estimated travel.

d. % Error - This is the absolute difference divided by the actual travel.

A per cent error is not calculated when ever the actual travel is 500 or less. This is because these small values are considered to be noise.

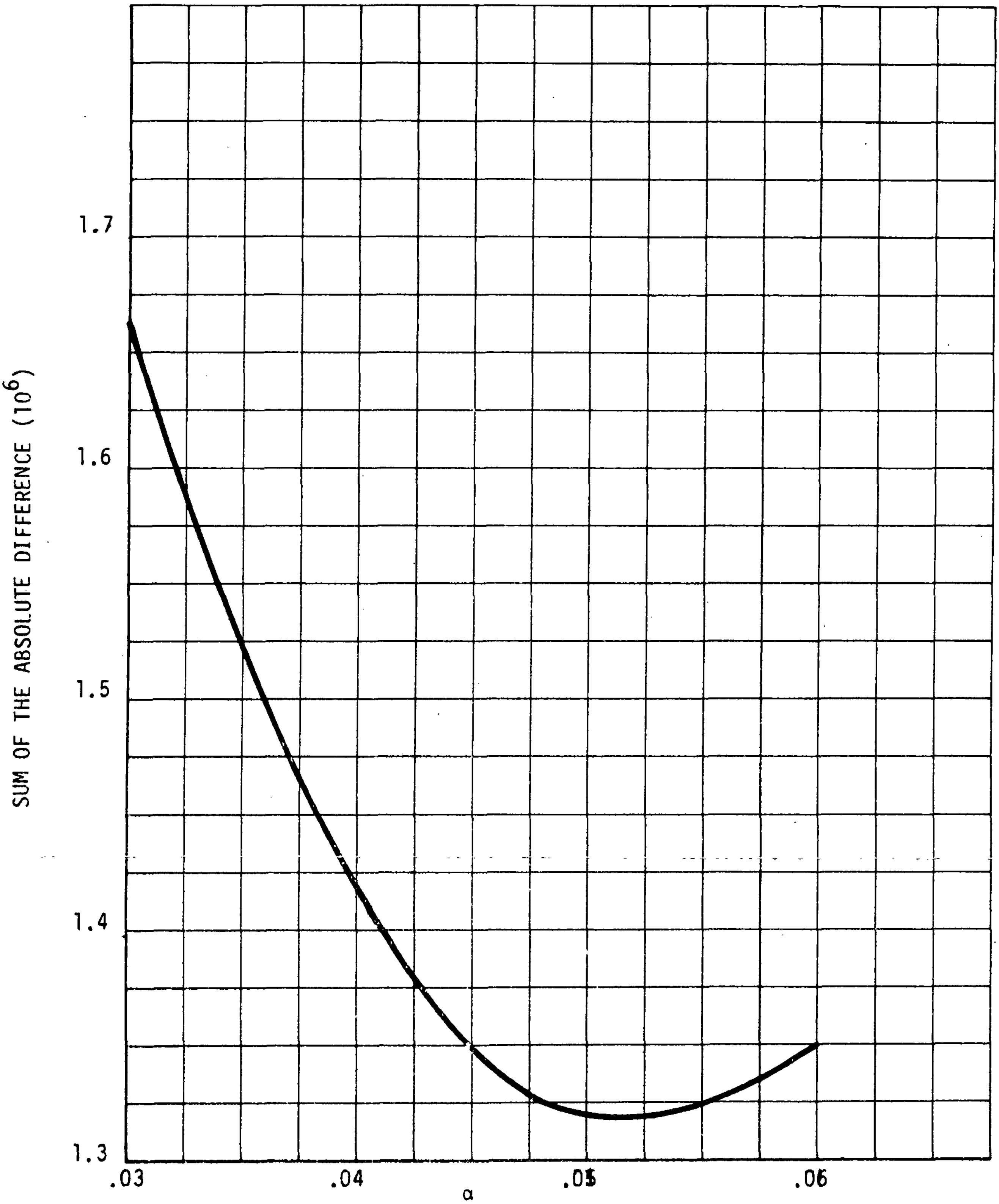

FIGURE 3
SUM OF THE ABSOLUTE DIFFERENCE FOR α = 0.03
TO α = 0.06 WHEN THE TOTAL ZONAL DEMAND IS KNOWN

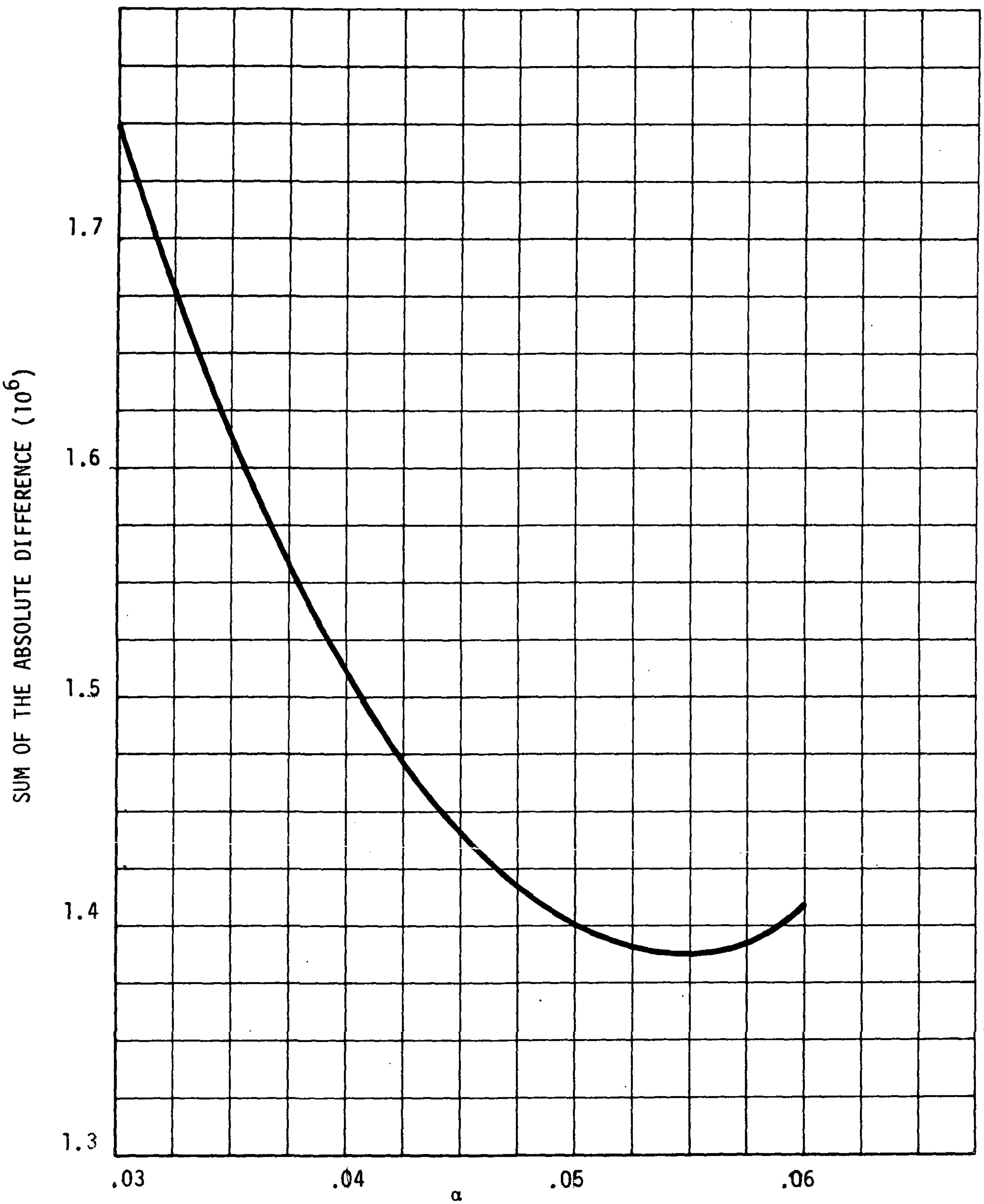

FIGURE 4
SUM OF THE ABSOLUTE DIFFERENCE FOR $\alpha = 0.03$
TO $\alpha = 0.06$ WHEN THE TOTAL ZONAL DEMAND IS ESTIMATED

For each of the 30 superzones, the following information is listed:

a. Actual Travel - This is the sum of the actual travel from one superzone to the other 29 superzones and is from the 1965 base data.

b. Estimated Travel - This is the sum of the estimated travel from one superzone to the other 29 superzones.

c. Absolute difference - This is the sum of the 29 absolute differences to each zone. The sum includes all values regardless of size.

d. % Error - This is the sum of the absolute differences divided by actual travel from one zone to the other 29 zones.

A final summary is displayed that shows

a. The total estimated Bay Area traffic which is the sum of traffic for all the 30 zones.

b. The total of absolute differences which is the sum of the absolute difference for all of the 30 zones.

B. Attachment 5 contains the same information as in Attachment 4 with the only differences being a different α and known total traffic out of a zone. The output is presented exactly as in Attachment 4.

8) Comparison to NECTP-230 (Northeast Corridor Study)

The Comparison to the NECTP-230 model was done by using the demand model, equation (2), to predict traffic for the Northeast Corridor. The basic difference between the two models is that in NECTP-230 the travel for the different modes is added together for the estimate of total travel, while with this technique the total travel is estimated first.

The data used for the comparison was from NECTP-230 and is

displayed in Tables 6 and 7. For the comparison, the following changes had to be made because of the symmetric and exponential properties of this technique.

A. No estimate for the Boston-New Haven path.

B. Travel estimates had to be made for the city-pairs

Baltimore - D. C.
Providence - Wilmington
Wilmington - New York

C. Population estimates had to be made in cases where the NECTP-230 model used different city sizes. An example is Providence, where the population varies from 718,543 to 1,326,548.

D. Actual highway distances were divided by 10 to make them comparable to the distances in the Bay Area. This makes it possible to start searching for an α in the .05 range. If this was not done, it would have been necessary to plot

$$\text{Log} \quad \left(\frac{ND_{ij}N_{ij}}{P_i}\right) \quad = \quad D_{ij}$$

and find an α for distances of the same magnitude as those in the Northeast Corridor. Further work needs to be done to find the proper divisor for any distance so an α can be estimated for general use.

Figure 5 shows how the seven zones were separated and where the centroids were placed. Tables 8, 9 and 10 show the congestion centers, distances and demands used in the model. The populations used for each zone or city are also included on the Tables.

Two different traffic estimates are presented. One is using an α typical for the Bay Area, (0.05), and the other used the best α, (0.072), for Northeast Corridor data. The α for the Northeast Corridor is for distances divided by 10. It would be possible to find the divisor that would make

TABLE 6
SUMMARY OF ACTUAL vs PREDICTED TOTAL DEMAND FOR THE CAM CALIBRATION BASED ON 19 MARKET PAIRS

Metrodistricts	Pair ID	Actual Demand (D)	Predicted Demand ($\hat{D}$)	Absolute Error $D - \hat{D}$	Percentage Error $\frac{D - \hat{D}}{D}$
Boston-New Haven	2-16	508,607	306,818	201,789	0.40
Boston-New York	3-08	3,509,841	4,107,719	597,878	0.17
Boston-Philadelphia	3-11	518,370	1,001,634	483,263	0.93
Boston-Wilmington	3-13	48,418	211,546	163,128	3.37
Boston-Baltimore	3-14	127,122	381,380	254,258	2.00
Boston-D.C.	3-15	562,530	1,023,877	461,350	0.82
Providence-New York	4-08	920,625	682,020	238,604	0.26
Providence-Baltimore	5-14	38,157	91,079	52,922	1.39
Providence-D.C.	5-15	93,541	244,506	150,965	1.61
Providence-Philadelphia	6-11	107,524	182,802	75,278	0.70
Philadelphia-Baltimore	11-14	1,509,375	443,133	1,066,241	0.71
Philadelphia-D.C.	11-15	2,019,612	1,139,197	880,414	0.44
Baltimore-New York	14-08	1,478,477	1,707,460	228,983	0.15
D.C.-New York	15-08	4,399,853	4,952,415	552,562	0.13
D.C.-Wilmington	15-13	394,823	264,206	130,617	0.33
Boston-Providence	1-04	5,612,492	783,879	4,828,613	0.86
Baltimore-Wilmington	14-13	766,052	145,238	620,814	0.81
Philadelphia-Wilmington	12-18	3,611,799	12,086,080	8,474,281	2.35
Philadelphia-New York	11-10	13,524,007	4,142,438	9,381,569	0.69
		39,751,223 $\sum$ Actual Demand		28,843,530 $\sum$ Absolute Error	

TABLE 7
SOCIO-ECONOMIC VARIABLES

Metro Pair	Metro ID	1960 Population		Aggregate Income* (millions)		Per Capita Income**		Hotel and Motel Receipts on a City Basis (thousands)	
		I	J	I	J	I	J	I	J
Boston-Providence	1-04	2,598,902	718,543	5465	1321	2103	1838	42218	5094
Boston-New Haven	2-16	3,357,607	660,315	7215	1499	2149	2270	42218	2762
Boston-New York	3-08	3,940,835	14,615,516	8312	35284	2109	2414	42218	221804
Boston-Philadelphia	3-11	3,940,835	4,546,107	8312	9530	2109	2096	42218	41100
Boston-Wilmington	3-13	3,940,835	429,339	8312	958	2109	2231	42218	3582
Boston-Baltimore	3-14	3,940,835	1,674,238	8312	3317	2109	1981	42218	12428
Boston-D.C.	3-15	3,940,835	2,001,897	8312	4990	2109	2493	42218	59800
Providence-New York	4-08	718,543	14,615,516	1321	35284	1838	2414	5094	221804
Providence-Baltimore	5-14	1,326,548	1,674,238	2375	3317	1790	1981	5094	12428
Providence-D.C.	5-15	1,326,548	2,001,897	2375	4990	1790	2493	5094	59800
Providence-Philadelphia	6-11	859,488	4,546,107	1563	9530	1819	2096	5094	41100
Philadelphia-New York	11-10	4,546,107	13,920,040	9530	33722	2096	2423	41100	221804
Philadelphia-Baltimore	11-14	4,546,107	1,674,238	9530	3317	2096	1981	41100	12428
Philadelphia-D.C.	11-15	4,546,107	2,001,897	9530	4990	2096	2493	41100	59800
Philadelphia-Wilmington	12-18	4,411,267	307,446	9278		2103	2391	41100	3582
Baltimore-New York	14-08	1,674,238	14,615,516	3317	35284	1981	2414	12428	221804
Baltimore-Wilmington	14-13	1,674,238	429,339	3317	958	1981	2231	12428	3582
D.C.-New York	15-09	2,001,897	15,929,420	4990	38609	2493	2424	59800	221804
D.C.-Wilmington	15-13	2,001,897	429,339	4990	958	2493	2231	59800	3582

*Aggregate income in 1959, of the population in 1960.
**Derived from aggregate income/population.

Source: County and City Data Book, 1962, U.S. Department of Commerce.

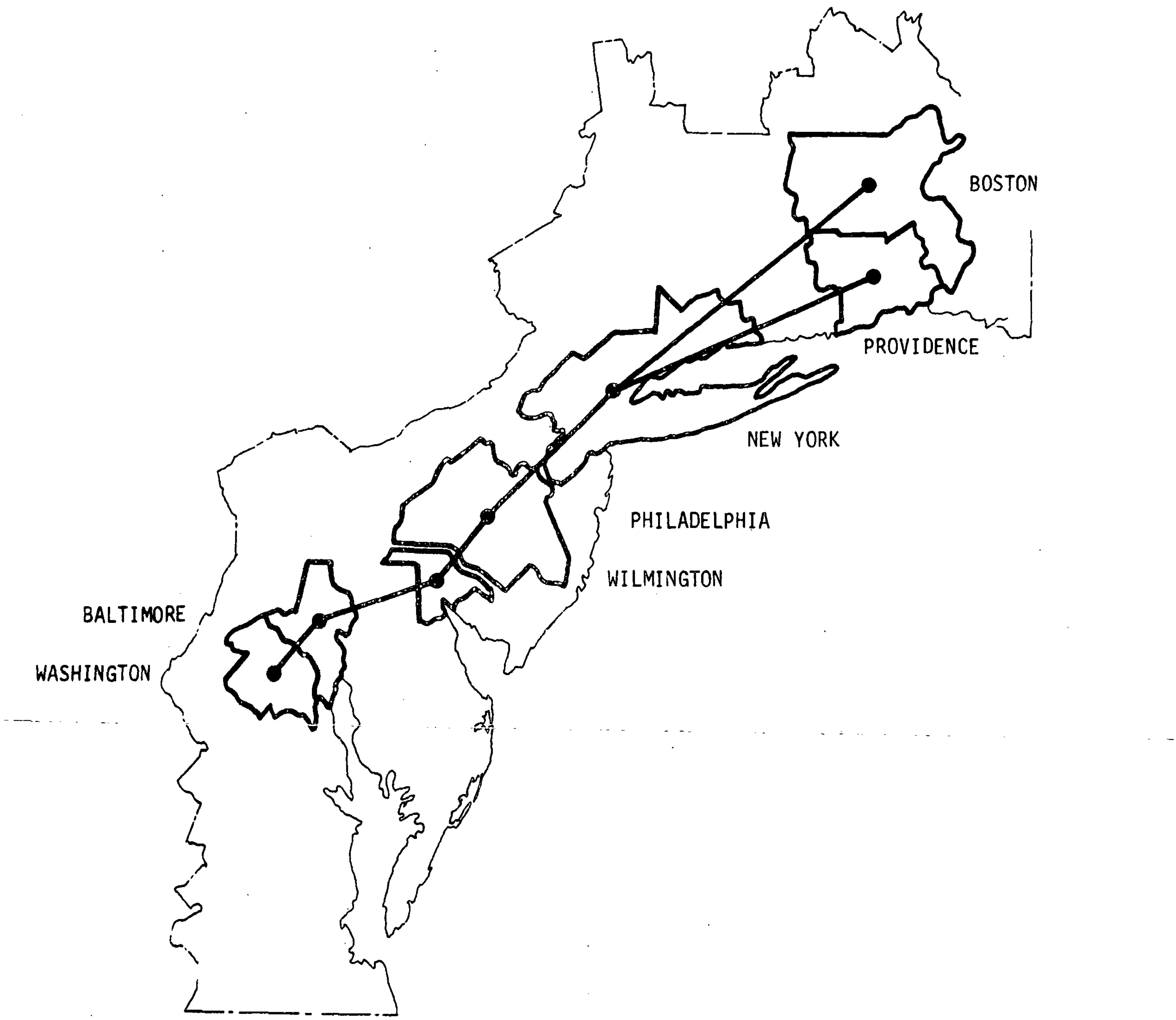

FIGURE 5
ZONAL STRUCTURE FOR THE NORTHEAST CORRIDOR

TABLE 8
CONGESTION POINTS (NODES) FOR THE NORTHEAST CORRIDOR

POPULATION	4,000	1,300	4,500	1,700	2,000	400	15,000
	BOSTON	PROVID.	PHILA.	BALTI.	D.C.	WILM.	N. Y.
BOSTON		2	3	5	6	4	2
PROVIDENCE	2		3	5	6	4	2
PHILADELPHIA	3	3		3	4	2	5
BALTIMORE	5	5	3		2	2	4
D. C.	6	6	4	2		3	5
WILMINGTON	4	4	2	2	3		3
N. Y.	2	2	5	4	5	3	

TABLE 9
HIGHWAY DISTANCES DIVIDED BY 10 FOR THE NORTHEAST CORRIDOR

POPULATION	4,000	1,300	4,500	1,700	2,000	400	15,000
	BOSTON	PROVID.	PHILA.	BALTI.	D. C.	WILM.	N. Y.
BOSTON		4.5	30.7	40.3	44.2	33.5	22.1
PROVIDENCE	4.5		26.8	36.4	40.3	29.6	18.2
PHILADELPHIA	30.7	26.8		9.7	13.6	2.8	10.1
BALTIMORE	40.3	36.4	9.7		3.9	6.9	19.7
D. C.	44.2	40.3	13.6	3.9		10.8	23.6
WILMINGTON	33.5	29.6	2.8	6.9	10.8		12.9
N. Y.	22.1	18.2	10.1	19.7	23.6	12.9	

TABLE 10
DEMANDS FOR THE NORTHEAST CORRIDOR

POPULATION	4,000	1,300	4,500	1,700	2,000	400	15,000
	BOSTON	PROVID.	PHILA.	BALT.	D.C.	WILM.	N. Y.
BOSTON		2806	259	64	281	24	1750
PROVIDENCE	2806		54	19	47	20	460
PHILADELPHIA	259	54		755	1010	1805	6762
BALTIMORE	64	19	755		2000	383	739
D. C.	281	47	1010	2000		200	2200
WILMINGTON	24	20	1805	383	200		200
N. Y.	1750	460	6762	739	2200	200	

the α equal to the one for the Bay Area; however, as noted earlier, this is a different problem which needs to be investigated.

Figure 6 shows the plot for the best α for the Northeast Corridor.

It should be noted at this point that all the changes that had to be made to the Northeast Corridor data to make it suitable for analysis would make the comparison more difficult for this model. Even with these changes, the model does a creditable job predicting Northeast Corridor traffic and outperforms the NECTP-230 model.

Table 11 shows how the model compares to the NECTP-230 model when both α's are used. The lower part of the table shows the absolute difference for the travel predictions. When α of 0.05 is used, the model predicts better for 11 out of 18 city-pairs and has a smaller sum of absolute differences. This difference is 50 per cent. When α of 0.072 is used, the model predicts better for 14 out of 18 city-pairs and also has a smaller sum of absolute difference. For this case the difference is by more than 65 per cent.

Since city-pairs 15, 17 and 18 account for almost 80% of the error in the NECTP-230 model, another approach will be used to compare the two models. This approach will remove the handicap of one large absolute difference which would contribute an unfair amount to the grand sum of absolute differences. At this point, it should be noted that in the NECTP-230 Report, city-pairs 15 through 18 were dropped and not included in later model calibration.

Table 12 compares the two models as the worst estimate is repeatedly discarded until only one is left. The estimates when α equals 0.05 have a lower sum of absolute differences 16 out of 18 times. When α equals 0.072, this model is better in every case.

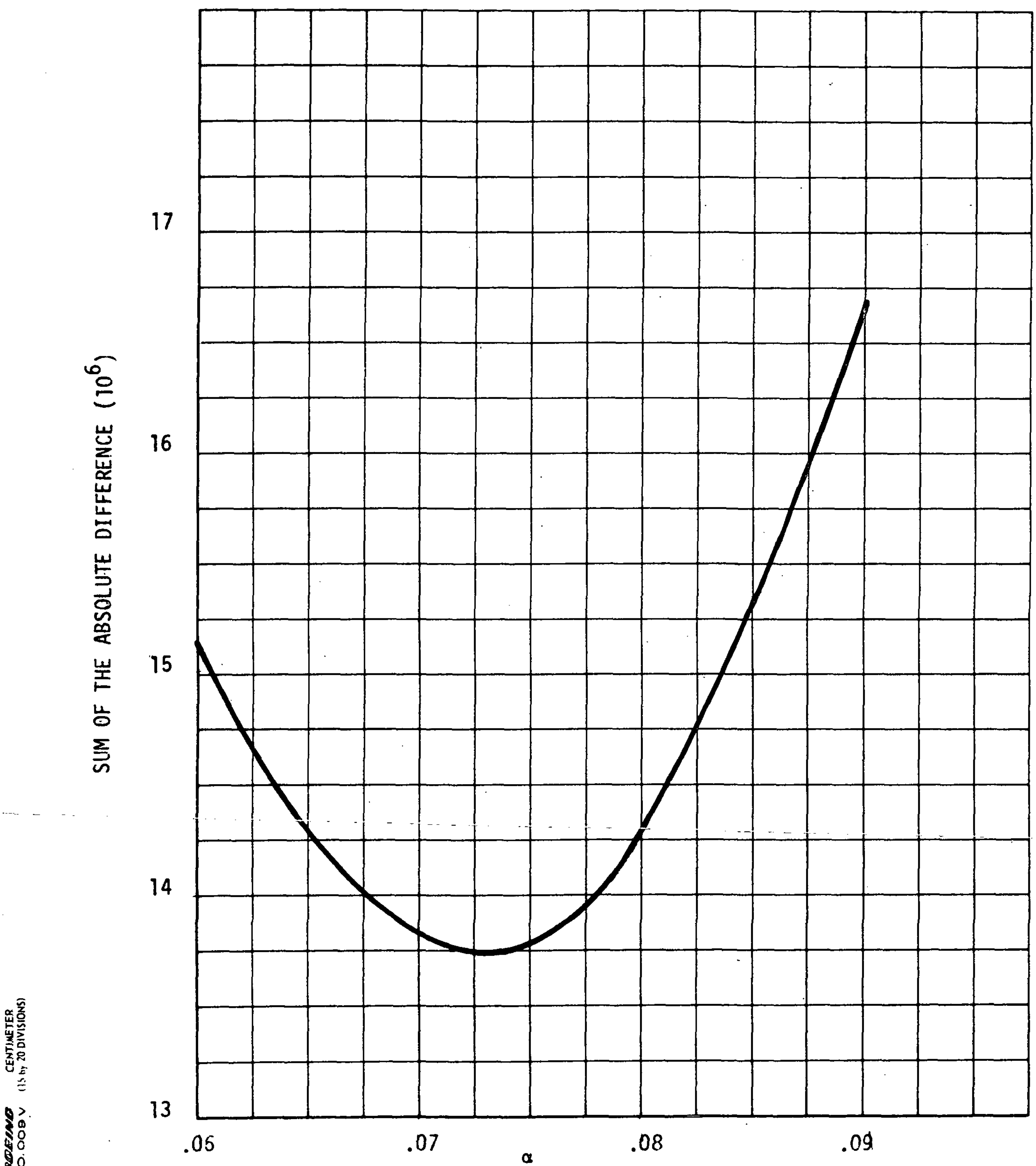

FIGURE 6
SUM OF THE ABSOLUTE DIFFERENCE FOR $\alpha = 0.06$
TO $\alpha = 0.09$ WHEN THE TOTAL ZONAL DEMAND IS KNOWN

TABLE 11a
TRAVEL PREDICTIONS AND COMPARISONS FOR
THE NORTHEAST CORRIDOR

	CITY-PAIR	ACTUAL DEMAND (000)	NECIP PREDICTION	BOEING PREDICTION a = .050	BOEING PREDICTION a = .072
1	Boston - New York	3510	4108	6049	4080
2	Boston - Philadelphia	518	1001	310	195
3	Boston - Wilmington	48	212	28	8
4	Boston - Baltimore	127	381	35	8
5	Boston - D. C.	563	1024	33	6
6	Providence - N. Y.	921	682	2997	2257
7	Providence - Baltimore	38	91	18	4
8	Providence - D. C.	94	245	17	3
9	Providence - Philadelphia	108	183	254	107
10	Philadelphia - Baltimore	1509	443	2580	2555
11	Philadelphia - D. C.	2020	1139	2098	1692
12	Baltimore - N. Y.	1478	1707	1810	1222
13	D. C. - N. Y.	4400	4952	1632	864
14	D. C. - Wilmington	395	264	366	320
15	Boston - Providence	5612	784	3806	5550
16	Baltimore - Wilmington	766	145	521	542
17	Philadelphia - Wilmington	3612	12086	2350	3087
18	Philadelphia - N. Y.	13524	4142	12479	13901

TABLE 11b
ABSOLUTE DIFFERENCES FOR TRAVEL PREDICTIONS
OF NORTHEAST CORRIDOR DATA

	NECTP	BOEING .050	BOEING .072
1	598	2539	570
2	483	208	323
3	164	20	40
4	254	92	119
5	461	530	557
6	239	2076	1336
7	53	20	34
8	151	77	91
9	75	146	1
10	1066	1071	1046
11	881	78	328
12	229	332	256
13	552	2768	3536
14	131	29	74
15	4828	1806	62
16	621	245	224
17	8474	1262	525
18	9382	1045	377
Σ ABSOLUTE DIFFERENCE	28642	14344	9500

TABLE 12
REDUCTION IN THE SUM OF ABSOLUTE DIFFERENCES
AS LARGEST DIFFERENCE IS REMOVED

STEP	NECTP PREDICTION	BOEING PREDICTION a = .050	BOEING PREDICTION a = .072
1	28642	14344	9500
2	19260	11576	5964
3	10786	9037	4628
4	5958	6961	3582
5	4892	5155	3012
6	4011	3893	2455
7	3390	2822	1930
8	2792	1777	1553
9	2240	1247	1225
10	1757	915	902
11	1296	670	646
12	1042	462	422
13	803	316	303
14	574	224	212
15	410	146	137
16	259	69	75
17	128	40	35
18	53	20	1

STEPWISE REGRESSION DISPLAY

BMD02R - STEPWISE REGRESSION - VERSION OF JUNE 2, 1964
HEALTH SCIENCES COMPUTING FACILITY, UCLA

PROBLEM CODE	BMD02R
NUMBER OF CASES	30
NUMBER OF ORIGINAL VARIABLES	5
NUMBER OF VARIABLES ADDED	0
TOTAL NUMBER OF VARIABLES	5
NUMBER OF SUB-PROBLEMS	1

FORMAT (5F10.0)

VARIABLE		MEAN	STANDARD DEVIATION
TRIPS	1	4.84784	.51995
EMRTE	2	4.92092	.36799
ABST	3	3.13318	.46395
APSRV	4	2.73873	.34395
ARES	5	3.73591	.39174

VARIABLE NUMBER	1	2	3	4	5
1	.270	.177	.047	.147	.091
2		.135	.036	.107	.064
3			.215	.065	.093
4				.118	.097
5					.153

CORRELATION MATRIX

VARIABLE NUMBER	1	2	3	4	5
1	1.000	.927	.193	.823	.448
2		1.000	.329	.848	.447
3			1.000	.405	.509
4				1.000	.722
5					1.000

Appendix A,
Attachment 1

SUB-PROBLEM 1
DEPENDENT VARIABLE 1
MAXIMUM NUMBER OF STEPS 10
F-LEVEL FOR INCLUSION .010000
F-LEVEL FOR DELETION .005000
TOLERANCE LEVEL .001000

STEP NUMBER 1
VARIABLE ENTERED 2

MULTIPLE R .9266
STD. ERROR OF EST. .1999

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	1	6.732	6.732	170.090
RESIDUAL	28	1.108	.040	

VARIABLES IN EQUATION				VARIABLES NOT IN EQUATION			
VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE	VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
(CONSTANT	-1.59517)						
EMRTE 2	1.30931	.10039	170.0904	ADST 3	-.31483	.8916	2.9706
				APSRV 4	.18332	.2804	.9389
				APES 5	.10133	.8000	.2801

STEP NUMBER 2
VARIABLE ENTERED 3

MULTIPLE R .9342
STD. ERROR OF EST. .1923

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	2	6.842	3.421	92.516
RESIDUAL	27	.998	.037	

VARIABLES IN EQUATION				VARIABLES NOT IN EQUATION			
VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE	VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
(CONSTANT	-1.44202)						
EMRTE 2	1.36764	.10277	177.1027	APSRV 4	.28562	.2627	2.3095
ADST 3	-.14049	.08151	2.9706	APES 5	.27551	.6530	2.1356

Appendix A,
Attachment 1

STEP NUMBER 3
VARIABLE ENTERED 4

MULTIPLE R .9397
STD. ERROR OF EST. .1878

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	3	6.923	2.308	65.438
RESIDUAL	26	.917	.035	

VARIABLES IN EQUATION					VARIABLES NOT IN EQUATION			
VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE		VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
(CONSTANT	-1.05817)							
EMRTE 2	1.14232	.17904	40.7067		ARES 5	.10928	.3291	.3022
ABST 3	-.17188	.08224	4.3681					
AFSRV 4	.30062	.19781	2.3095					

STEP NUMBER 4
VARIABLE ENTERED 5

MULTIPLE R .9404
STD. ERROR OF EST. .1904

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	4	6.934	1.734	47.837
RESIDUAL	25	.906	.036	

VARIABLES IN EQUATION					VARIABLES NOT IN EQUATION			
VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE		VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
(CONSTANT	-1.29112)							
EMPTE 2	1.19541	.20560	33.8064					
ABST 3	-.19010	.08971	4.4901					
AFSRV 4	.19127	.28245	.4586					
ARES 5	.08646	.14723	.3022					

F-LEVEL INSUFFICIENT FOR FURTHER COMPUTATION

Appendix A,
Attachment 1

SUMMARY TABLE

STEP NUMBER	VARIABLE ENTERED	REMOVED	MULTIPLE R	RSQ	INCREASE IN RSQ	F VALUE TO ENTER OR REMOVE	NUMBER OF INDEPENDENT VARIABLES INCLUDED
1	EMRTE 2		.9266	.8587	.8587	170.0904	1
2	ABST 3		.9342	.8727	.0140	2.9706	2
3	AFSRV 4		.9397	.8830	.0104	2.3095	3
4	ARES 5		.9404	.8844	.0014	.3022	4

ESTIMATION OF α FROM ACTUAL TOTAL DEMAND

Appendix A,
Attachment 2

ACTUAL AND ESTIMATED DEMAND
ALPHA= .050

SUPERZONE	1	2	3	4	5	6	7	8	9	10
TOTAL ACTUAL	330503.0	221623.0	203475.0	189486.0	164905.0	128321.0	136242.0	181381.0	319508.0	161839.0
TOTAL ESTIM.	272667.2	238183.3	192398.7	269638.3	197291.9	134785.6	124639.6	159287.5	300470.8	128156.8
DIFFERENCE	11269.9	122557.3	42494.9	102087.9	70241.6	41705.6	39031.2	49823.5	117891.3	68511.9

SUPERZONE	11	12	13	14	15	16	17	18	19	20
TOTAL ACTUAL	34457.0	8198.0	15394.0	73324.0	141438.0	191743.0	292651.0	195082.0	102428.0	48927.0
TOTAL ESTIM.	137063.8	5960.2	13969.6	77772.0	144713.6	190834.8	249172.5	206213.2	131043.4	35636.0
DIFFERENCE	96042.9	4734.7	12220.7	64153.0	57027.4	44335.2	68435.9	39320.7	40020.9	26537.9

SUPERZONE	21	22	23	24	25	26	27	28	29	30
TOTAL ACTUAL	82471.0	19786.0	30464.0	8567.0	16380.0	4388.0	23337.0	30487.0	38335.0	57149.0
TOTAL ESTIM.	73233.8	20869.2	32130.2	1043.4	13548.6	3702.3	15162.0	35719.1	31476.0	56009.0
DIFFERENCE	33311.5	6772.4	18046.2	4192.2	16173.0	2832.2	8092.6	10327.4	25374.9	38949.4

Appendix A,

Attachment 2

CASE 1
1969 DATA

SEQ.	ALPHA	DEMAND	ABS. DIFF.
1	.020	3509820	2042191
2	.022	3509820	1994173
3	.024	3509820	1830748
4	.026	3509820	1901176
5	.028	3509820	1720911
6	.030	3509820	1656269
7	.032	3509820	1597456
8	.034	3509820	1544815
9	.036	3509820	1497507
10	.038	3509820	1453028
11	.040	3509820	1412518
12	.042	3509820	1384533
13	.044	3509820	1360728
14	.046	3509820	1341038
15	.048	3509820	1328984
16	.050	3509820	1323346
17	.052	3509820	1323654
18	.054	3509820	1326997
19	.056	3509820	1333509
20	.058	3509820	1342360
21	.060	3509820	1352111

TOTAL ACTUAL DEMAND 3509820

TABLE OF ESTIMATED DEMANDS

SEQ.	ALPHA	DEMAND	ABS. DIFF.
1	.050	3509820	1323346
2	.052	3509820	1323654
3	.054	3509820	1326997
4	.046	3509820	1328944
5	.056	3509820	1333509
6	.046	3509820	1341038
7	.058	3509820	1342760
8	.060	3509820	1352111
9	.044	3509820	1360728
10	.042	3509820	1384533
11	.040	3509820	1412618
12	.038	3509820	1453028
13	.036	3509820	1497507
14	.034	3509820	1544815
15	.032	3509820	1597456
16	.030	3509820	1656269
17	.028	3509820	1720911
18	.026	3509820	1901176
19	.024	3509820	1830748
20	.022	3509820	1994173
21	.020	3509820	2042191

ESTIMATION OF a FROM
ESTIMATED TOTAL DEMAND

Appendix A,
Attachment 3

ACTUAL AND ESTIMATED DEMAND
BASED ON ESTIMATED TOTAL DEMAND
ALPHA= .056

SUPERZONE	1	2	3	4	5	6	7	8	9	10
TOTAL ACTUAL	339503.0	221629.0	203475.0	189486.0	164935.0	128321.0	136242.0	181381.0	319504.0	161839.0
TOTAL ESTIM.	259420.5	226095.1	193371.5	257353.8	201531.7	145837.0	116831.5	127560.2	246452.9	82528.2
DIFFERENCE	80169.0	103651.3	46654.3	82120.1	63231.6	42970.9	51827.8	66941.9	146340.9	85005.3

SUPERZONE	11	12	13	14	15	16	17	18	19	20
TOTAL ACTUAL	84457.0	8093.0	15394.0	78324.0	1414 8.0	191749.0	292651.0	195082.0	102424.0	48927.0
TOTAL ESTIM.	107189.1	7177.3	16382.2	68888.4	135826.0	160797.6	284456.1	202619.4	131926.1	23578.0
DIFFERENCE	27529.3	5093.7	12743.2	65051.2	46239.1	42303.4	76435.5	38376.8	51533.7	37101.3

SUPERZONE	21	22	23	24	25	26	27	28	29	30
TOTAL ACTUAL	82471.0	13786.0	30464.0	8567.0	13380.0	4388.0	23397.0	30487.0	38335.0	57149.0
TOTAL ESTIM.	98507.6	33125.8	44900.8	18227.2	18885.3	4015.8	12933.5	37679.2	32532.9	67347.4
DIFFERENCE	55539.0	19675.9	23349.4	11008.9	6326.2	2329.3	10802.6	16856.5	29863.3	45991.3

Appendix A,

Attachment 3

CASE 3
1965 DATA

SEQ.	ALPHA	DEMAND	ABS. DIFF.
1	.020	3368479	2151220
2	.022	3368478	2051104
3	.024	3368479	1961332
4	.026	3368478	1895510
5	.028	3368479	1817384
6	.030	3368479	1754621
7	.032	3368479	1694551
8	.034	3368479	1637342
9	.036	3368479	1584210
10	.038	3368478	1541496
11	.040	3368479	1506251
12	.042	3368479	1473919
13	.044	3368478	1446790
14	.046	3368479	1426064
15	.048	3368479	1411052
16	.050	3368479	1399402
17	.052	3368479	1395046
18	.054	3368479	1393494
19	.056	3368479	1392983
20	.058	3368479	1398178
21	.060	3368479	1407993

TOTAL ACTUAL DEMAND 3509820

TABLE OF ESTIMATED DEMANDS

SEQ.	ALPHA	DEMAND	ABS. DIFF.
1	.056	3368479	1392983
2	.054	3368479	1393494
3	.052	3368479	1395046
4	.058	3368479	1398178
5	.050	3368479	1399402
6	.060	3368478	1407993
7	.048	3368479	1411052
8	.046	3368479	1426064
9	.044	3368479	1446790
10	.042	3368479	1473919
11	.040	3368479	1506251
12	.038	3368478	1541496
13	.036	3368479	1584210
14	.034	3368479	1637342
15	.032	3368479	1694551
16	.030	3368479	1754621
17	.028	3368478	1817384
18	.026	3368479	1895510
19	.024	3368479	1961332
20	.022	3368479	2051104
21	.020	3368479	2151220

TRAVEL ESTIMATES

USING α OF 0.056

Appendix A,

Attachment 4

ACTUAL AND ESTIMATED TOTAL DEMAND

ZONE	ACTUAL	ESTIMATED
1	330503.0	391079.6
2	221628.0	182951.5
3	203475.0	198160.3
4	183496.0	144832.4
5	154905.0	180254.1
6	128321.0	166432.8
7	135242.0	125232.5
8	131391.0	129130.6
9	319503.0	314435.6
10	161839.0	81241.5
11	84457.0	39897.7
12	9098.0	12406.8
13	15934.0	21970.5
14	76324.0	70061.0
15	141408.0	137747.8
16	131743.0	120825.7
17	292651.0	321605.0
18	195092.0	172878.5
19	102426.0	108280.1
20	43927.0	15771.0
21	82471.0	118997.7
22	19785.0	34671.9
23	30434.0	46314.3
24	8567.0	26713.7
25	13380.0	26381.4
26	4398.0	3990.7
27	23397.0	13533.5
28	30487.0	43431.8
29	38335.0	32432.9
30	57149.0	86756.1

ACTUAL AND ESTIMATED DEMAND
~~BASED ON ESTIMATED TOTAL DEMAND~~
ALPHA= .055

Appendix A,

Attachment 4

SUPERZONE	1	2	3	4	5	6	7	8	9	10
1 ACTUAL	0.0	39394.0	50597.0	55534.0	27163.0	13898.0	6329.0	1897.0	3250.0	809.0
EST.	0.0	68953.9	52858.2	54411.8	24881.4	3280.5	559.7	172.5	108.8	9.8
DIFF.	0.0	30436.1	2261.2	1122.2	2281.6	10617.5	5769.3	1724.5	3141.2	799.2
DIF/ACT.	0.00	.31	.04	.02	.08	.76	.91	.91	.97	.99
2 ACTUAL	39394.0	0.0	31185.0	45125.0	12313.0	4552.0	1562.0	1308.0	744.0	0.0
EST.	68953.9	0.0	18496.9	71353.0	22645.1	3734.7	662.6	204.9	136.1	9.3
DIFF.	30430.1	0.0	13388.1	26238.0	9732.1	817.3	899.4	1103.1	607.9	9.3
DIF/ACT.	.31	0.00	.42	.58	.75	.18	.58	.84	.82	0.00
3 ACTUAL	50597.0	31185.0	0.0	44478.0	30982.0	8177.0	1793.0	1687.0	2272.0	951.0
EST.	52858.2	18436.9	0.0	39828.6	35438.2	8837.9	1450.6	430.1	273.1	18.7
DIFF.	2261.2	13358.1	0.0	4649.4	4456.2	660.9	342.4	1256.9	1998.9	932.3
DIF/ACT.	.04	.42	0.00	.10	.14	.08	.19	.75	.88	.98
4 ACTUAL	55534.0	45125.0	44478.0	0.0	27213.0	3574.0	1220.0	421.0	635.0	0.0
EST.	54411.8	71353.0	39623.6	0.0	57408.3	3174.0	1543.6	458.6	300.6	19.7
DIFF.	1122.2	26238.0	4853.4	0.0	30255.3	3600.0	323.6	37.6	334.4	19.7
DIF/ACT.	.02	.58	.10	0.00	1.11	1.57	.27	0.00	.53	0.00
5 ACTUAL	27163.0	12313.0	30932.0	27213.0	0.0	37859.0	7501.0	3444.0	3563.0	1021.0
EST.	24881.4	22545.1	35433.2	57468.3	0.0	39986.4	5893.1	1639.5	1012.6	66.2
DIFF.	2281.6	9732.1	4455.2	30255.3	0.0	2127.4	1707.9	1804.5	2550.4	954.8
DIF/ACT.	.08	.75	.14	1.11	0.00	.06	.22	.52	.72	.94
6 ACTUAL	13898.0	4552.0	8177.0	3574.0	37859.0	0.0	40331.0	5445.0	6095.0	1142.0
EST.	3280.5	3734.7	8837.9	9174.0	39986.4	0.0	47204.9	11651.0	6544.5	427.5
DIFF.	10617.5	817.3	660.9	5600.0	2127.4	0.0	6873.9	6206.0	449.5	714.5
DIF/ACT.	.76	.18	.08	1.57	.06	0.00	.17	1.14	.07	.63
7 ACTUAL	6329.0	1562.0	1793.0	1220.0	7501.0	40331.0	0.0	50303.0	17736.0	2710.0
EST.	559.7	662.6	1450.6	1543.6	5893.1	47204.9	0.0	29585.8	14690.7	906.3
DIFF.	5769.3	899.4	342.4	323.6	1707.9	6873.9	0.0	20717.2	3045.3	1803.7
DIF/ACT.	.91	.58	.19	.27	.22	.17	0.00	.41	.17	.67
8 ACTUAL	1897.0	1308.0	1687.0	421.0	3444.0	5445.0	50303.0	0.0	92336.0	10481.0
EST.	172.5	204.9	430.1	458.6	1639.5	11651.0	29585.8	0.0	67551.7	3706.8
DIFF.	1724.5	1103.1	1256.9	37.6	1804.5	6206.0	20717.2	0.0	24784.3	6774.2
DIF/ACT.	.91	.84	.75	0.00	.52	1.14	.41	0.00	.27	.65
9 ACTUAL	3250.0	744.0	2272.0	635.0	3563.0	6095.0	17736.0	92336.0	0.0	126754.0
EST.	108.8	136.1	273.1	300.6	1012.6	6544.5	14690.7	67551.7	0.0	57597.9
DIFF.	3141.2	607.9	1998.9	334.4	2550.4	449.5	3045.3	24784.3	0.0	69156.1
DIF/ACT.	.97	.82	.88	.53	.72	.07	.17	.27	0.00	.55
10 ACTUAL	809.0	0.0	951.0	0.0	1021.0	1142.0	2710.0	10481.0	126754.0	0.0

EST.	9.8	9.3	13.7	19.7	66.2	427.5	306.3	3706.8	57597.9	0.0
DIFF.	733.2	9.3	932.3	19.7	954.8	714.5	1803.7	6774.2	69156.1	0.0
DIF/ACT.	.99	0.00	.98	0.00	.94	.63	.67	.65	.55	0.00
11 ACTUA_	125.0	220.0	309.0	0.0	1021.0	1183.0	2072.0	8341.0	53546.0	13185.0
EST.	18.8	14.9	34.8	27.2	110.2	904.2	1988.6	8158.0	75420.6	13944.5
DIFF.	107.2	205.1	273.2	27.2	910.8	278.8	83.4	183.0	21874.6	759.5
DIF/ACT.	0.00	0.00	0.00	0.00	.83	.24	.04	.02	.41	.06
12 ACTUA_	13.0	83.0	0.0	0.0	296.0	0.0	0.0	377.0	4000.0	2267.0
EST.	.5	.8	1.5	1.9	5.6	28.5	55.4	211.6	1553.1	3935.5
DIFF.	12.5	82.2	1.5	1.9	290.4	28.5	55.4	165.4	2445.9	1668.5
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.61	.74
13 ACTUAL	309.0	52.0	437.0	116.0	271.0	89.0	152.0	253.0	127.0	149.0
EST.	50.2	35.4	46.9	24.7	27.4	168.9	337.5	155.9	808.8	74.1
DIFF.	258.8	16.6	390.1	91.3	243.6	79.9	185.5	97.1	681.8	74.9
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14 ACTUAL	528.0	326.0	1547.0	783.0	1333.0	1236.0	1627.0	3181.0	3810.0	963.0
EST.	223.0	131.1	93.5	110.1	375.1	3645.7	7757.7	2297.9	15357.7	1352.1
DIFF.	305.0	194.9	1453.5	672.9	957.9	2349.7	6130.7	883.1	11547.7	389.1
DIF/ACT.	.58	0.00	.94	.86	.72	1.31	3.77	.28	3.03	.40
15 ACTUA_	2928.0	707.0	2164.0	249.0	655.0	1077.0	571.0	456.0	1171.0	288.0
EST.	2060.9	1071.1	1561.7	910.7	1186.9	4923.4	2234.9	690.2	2785.9	263.6
DIFF.	867.1	364.1	533.3	661.7	531.9	3846.4	1563.9	234.2	1614.9	24.4
DIF/ACT.	.30	.51	.28	0.00	.81	3.57	2.33	0.00	1.38	0.00
16 ACTUAL	4371.0	2307.0	2273.0	528.0	613.0	484.0	139.0	208.0	516.0	86.0
EST.	3669.9	1509.0	2490.8	950.6	865.7	1669.9	800.2	254.5	975.4	84.5
DIFF.	701.1	638.0	212.8	422.6	252.7	1185.9	661.2	46.5	459.4	1.5
DIF/ACT.	.16	.30	.09	.80	.41	0.00	0.00	0.00	.89	0.00
17 ACTUAL	15524.0	4903.0	7276.0	3732.0	2615.0	1035.0	386.0	572.0	971.0	196.0
EST.	17431.6	8549.3	12571.3	5294.7	3817.7	1458.5	722.3	234.2	837.8	74.6
DIFF.	1907.6	3940.3	5295.3	1562.7	1202.7	393.5	336.3	337.8	133.2	121.4
DIF/ACT.	.12	.80	.73	.42	.46	.36	0.00	.59	.14	0.00
18 ACTUA_	12735.0	3087.0	3824.0	1732.0	1544.0	483.0	519.0	134.0	641.0	224.0
EST.	12816.3	5703.3	8636.2	3352.7	2543.0	851.7	179.7	59.2	207.2	18.1
DIFF.	81.3	2616.3	4812.2	1620.7	999.0	368.7	339.3	74.8	433.8	205.9
DIF/ACT.	.01	.85	1.26	.94	.65	0.00	.65	0.00	.68	0.00
19 ACTUAL	5534.0	1106.0	4353.0	728.0	879.0	423.0	24.0	0.0	428.0	76.0
EST.	5837.2	2702.8	4109.2	1627.9	1240.7	426.7	91.6	30.6	104.0	9.1
DIFF.	[illegible]	1596.8	243.8	899.9	361.7	3.7	67.6	30.6	324.0	66.9
DIF/ACT.	.05	1.44	.06	1.24	.41	0.00	0.00	0.00	0.00	0.00
20 ACTUAL	1012.0	248.0	463.0	39.0	293.0	0.0	48.0	0.0	0.0	0.0
EST.	216.0	106.0	153.8	66.2	49.5	25.3	5.2	1.7	6.1	.5
DIFF.	795.0	142.0	281.2	27.2	243.5	25.3	42.8	1.7	6.1	.5
DIF/ACT.	.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21 ACTUAL	5754.0	563.0	1832.0	146.0	876.0	249.0	341.0	148.0	533.0	137.0
EST.	1820.6	1147.9	1553.1	767.8	512.9	233.4	41.5	25.4	140.3	6.0
DIFF.	3933.4	584.9	322.9	621.8	363.1	15.6	299.5	122.6	392.7	131.0

Appendix A,
Attachment 4

DIF/ACT.	.68	1.04	.17	0.00	.41	0.00	0.00	0.00	.74	0.00
22 ACTUAL	303.0	137.0	74.0	0.0	35.0	40.0	0.0	0.0	40.0	0.0
EST.	123.5	50.1	103.8	54.7	36.5	15.8	3.4	2.1	14.3	.5
DIFF.	179.5	56.9	-34.9	-54.7	-1.5	24.2	-3.4	-2.1	25.7	-.5
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23 ACTUAL	1374.0	775.0	564.0	320.0	142.0	38.0	83.0	85.0	0.0	124.0
EST.	309.5	226.6	300.9	163.7	106.8	45.8	9.4	3.1	10.1	1.0
DIFF.	1064.5	548.4	263.1	156.3	35.2	-7.8	73.6	81.9	10.1	123.0
DIF/ACT.	.77	.71	.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24 ACTUAL	39.0	114.0	0.0	0.0	64.0	0.0	0.0	34.0	0.0	93.0
EST.	36.1	32.5	40.5	24.8	15.2	5.6	1.1	.4	1.2	.1
DIFF.	2.9	81.5	40.5	24.8	48.8	5.6	1.1	33.6	1.2	92.9
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25 ACTUAL	100.0	0.0	143.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0
EST.	49.3	53.6	55.9	59.8	32.1	7.9	1.6	.5	1.6	.2
DIFF.	50.7	83.6	87.1	59.8	7.1	7.9	1.6	.5	1.6	.2
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26 ACTUAL	47.0	154.0	23.0	0.0	0.0	0.0	23.0	88.0	0.0	0.0
EST.	2.1	2.4	2.4	1.8	1.0	.2	.0	.0	.1	.0
DIFF.	44.9	151.6	20.6	1.8	1.0	.2	23.0	88.0	.1	.0
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27 ACTUAL	248.0	266.0	68.0	48.0	399.0	62.0	96.0	104.0	224.0	0.0
EST.	2.8	6.8	1.5	4.1	1.5	.2	.0	.0	.0	.0
DIFF.	245.2	259.2	66.4	43.9	397.5	61.8	96.0	104.0	224.0	.0
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 ACTUAL	356.0	117.0	587.0	140.0	74.0	0.0	0.0	0.0	0.0	0.0
EST.	50.7	142.7	31.5	84.1	31.0	4.1	.8	.3	.2	.0
DIFF.	305.3	25.7	555.5	55.9	43.0	4.1	.8	.3	.2	.0
DIF/ACT.	0.00	0.00	.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29 ACTUAL	2502.0	804.0	545.0	170.0	380.0	0.0	0.0	0.0	0.0	153.0
EST.	288.5	593.5	149.5	331.7	144.2	19.5	3.6	1.2	.8	.1
DIFF.	2213.5	210.5	395.5	221.7	235.8	19.5	3.6	1.2	.8	152.9
DIF/ACT.	.88	0.00	.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30 ACTUAL	17724.0	8587.0	4032.0	2555.0	1596.0	728.0	476.0	78.0	116.0	30.0
EST.	3111.3	17438.4	3777.5	8866.3	1397.8	531.2	99.6	32.7	21.9	1.7
DIFF.	8612.7	8851.4	254.5	6311.3	198.2	197.8	376.4	45.3	94.1	28.3
DIF/ACT.	.49	1.03	.06	2.47	.12	.27	0.00	0.00	0.00	0.00
TOTAL ACTUAL	330503.0	221528.0	203475.0	169436.0	164905.0	129321.0	136242.0	181381.0	313508.0	161839.0
TOTAL ESTIM.	250420.5	226035.1	143371.5	257353.8	201531.7	145837.0	110431.5	127560.2	245662.9	82528.2
DIFFERENCE	80159.0	103851.3	45654.3	82120.1	63230.6	42970.9	51927.8	66941.9	145340.9	85005.3
DIFF./ACTUAL	.24	.47	.22	.43	.39	.33	.38	.37	.46	.53
SUPERZONE	11	12	13	14	15	16	17	18	19	20

Appendix A,
Attachment 4

1	ACTUAL	126.0	13.0	303.0	528.0	2526.0	4371.0	15524.0	12735.0	5594.0	1012.0
	EST.	18.8	.5	50.2	223.0	2066.9	3569.9	17431.6	12816.3	5887.2	216.0
	DIFF.	107.2	12.5	253.8	305.0	867.1	701.1	1907.6	81.3	293.2	796.0
	DIF/ACT.	0.10	0.00	0.00	.58	.30	.16	.12	.01	.05	.79
2	ACTUAL	220.0	83.0	52.0	326.0	707.0	2307.0	4803.0	3087.0	1106.0	248.0
	EST.	14.9	.8	32.4	131.1	1071.1	1609.0	8643.3	5703.3	2702.8	106.0
	DIFF.	205.1	82.2	19.5	194.9	364.1	698.0	3846.3	2616.3	1596.8	142.0
	DIF/ACT.	0.00	0.00	0.00	0.00	.51	.30	.80	.85	1.44	0.00
3	ACTUAL	306.0	0.0	437.0	1547.0	2168.0	2278.0	7276.0	3824.0	4358.0	440.0
	EST.	34.8	1.5	45.9	93.5	1569.7	2490.8	12571.3	8636.2	4103.2	158.8
	DIFF.	273.2	1.5	391.1	1453.5	598.3	212.8	5295.3	4812.2	243.8	281.2
	DIF/ACT.	0.00	0.00	0.00	.94	.25	.09	.73	1.26	.06	0.00
4	ACTUAL	0.0	0.0	115.0	783.0	249.0	528.0	3732.0	1732.0	728.0	39.0
	EST.	27.2	1.9	24.7	110.1	910.7	950.6	5294.7	3352.7	1627.9	66.2
	DIFF.	27.2	1.9	91.3	672.9	661.7	422.6	1562.7	1620.7	893.9	27.2
	DIF/ACT.	0.00	0.00	0.00	.86	0.00	.80	.42	.94	1.24	0.00
5	ACTUAL	1021.0	236.0	271.0	1363.0	655.0	613.0	2515.0	1544.0	879.0	298.0
	EST.	110.2	5.6	27.4	375.1	1186.9	865.7	3817.7	2543.6	1240.7	49.5
	DIFF.	910.8	230.4	243.6	987.9	531.9	252.7	1202.7	999.6	361.7	248.5
	DIF/ACT.	.89	0.00	0.00	.72	.81	.41	.46	.65	.41	0.00
6	ACTUAL	1193.0	0.0	83.0	1296.0	1077.0	494.0	1095.0	483.0	423.0	0.0
	EST.	904.2	28.5	163.9	3645.7	4923.4	1669.9	1488.5	851.7	426.7	25.3
	DIFF.	278.8	28.5	73.3	2349.7	3846.4	1185.9	393.5	368.7	3.7	25.3
	DIF/ACT.	.24	0.00	0.00	1.81	3.57	0.00	.36	0.00	0.00	0.00
7	ACTUAL	2072.0	0.0	152.0	1627.0	671.0	139.0	386.0	519.0	24.0	48.0
	EST.	1988.6	55.4	337.5	7757.7	2234.9	800.2	722.3	179.7	91.6	5.2
	DIFF.	83.4	55.4	185.5	6130.7	1563.9	661.2	336.3	339.3	67.6	42.8
	DIF/ACT.	.04	0.00	0.00	3.77	2.33	0.00	0.00	.65	0.00	0.00
8	ACTUAL	8341.0	377.0	253.0	3181.0	456.0	208.0	572.0	134.0	0.0	0.0
	EST.	8159.0	211.6	155.9	2297.9	690.2	254.5	234.2	59.2	30.6	1.7
	DIFF.	183.0	155.4	97.1	883.1	234.2	46.5	337.8	74.8	30.6	1.7
	DIF/ACT.	.02	0.00	0.00	.28	0.00	0.00	.59	0.00	0.00	0.00
9	ACTUAL	53546.0	4300.0	127.0	3910.0	1171.0	516.0	371.0	641.0	423.0	0.0
	EST.	75420.6	1553.1	603.5	15357.7	2785.9	975.4	837.8	207.2	104.0	6.1
	DIFF.	21874.6	2446.9	631.8	11447.7	1614.9	459.4	133.2	433.8	324.0	6.1
	DIF/ACT.	.41	.61	0.00	3.03	1.38	.89	.14	.68	0.00	0.00
10	ACTUAL	13185.0	2257.0	143.0	363.0	288.0	36.0	196.0	224.0	70.0	0.0
	EST.	13944.5	3335.5	74.1	1352.1	263.6	84.5	74.6	18.1	3.1	.5
	DIFF.	759.5	1658.5	74.3	389.1	24.4	1.5	121.4	205.9	66.9	.5
	DIF/ACT.	.16	.74	0.10	.04	0.00	0.00	0.00	0.00	0.00	0.00
11	ACTUAL	0.0	1049.0	233.0	2059.0	315.0	135.0	170.0	250.0	93.0	0.0
	EST.	0.0	1238.4	253.2	3326.9	699.3	181.6	182.4	33.9	16.5	1.1
	DIFF.	0.0	189.4	38.8	1857.9	384.9	46.6	12.4	216.1	76.5	1.1
	DIF/ACT.	0.00	.18	0.00	.90	0.00	0.00	0.00	0.00	0.00	0.00
12	ACTUAL	1049.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix A,
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EST.	1233.4	0.0	4.3	101.2	21.9	7.9	6.1	1.6	.8	.0
DIFF.	183.4	0.0	4.3	101.2	21.9	7.9	6.1	1.6	.8	.0
DIF/ACT.	.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13 ACTUAL	298.0	0.0	0.0	2111.0	4849.0	1622.0	1228.0	500.0	251.0	732.0
EST.	259.2	4.3	0.0	7410.7	4014.8	125.1	99.5	49.0	21.1	18.5
DIFF.	38.8	4.3	0.0	5299.7	834.2	1496.9	1128.5	451.0	229.9	713.5
DIF/ACT.	0.03	0.00	0.00	2.51	.17	.92	.92	.90	0.00	.97
14 ACTUAL	2059.0	0.0	2111.0	0.0	39653.0	7793.0	7575.0	2169.0	324.0	0.0
EST.	3926.9	101.2	7410.7	0.0	16569.7	4373.6	3524.9	791.0	377.4	25.2
DIFF.	1857.9	101.2	5299.7	0.0	23083.3	3419.4	4050.1	1378.0	53.4	25.2
DIF/ACT.	.90	0.00	2.51	0.00	.58	.44	.53	.64	0.00	0.00
15 ACTUAL	315.0	0.0	4849.0	39653.0	0.0	48997.0	27449.0	4819.0	1450.0	282.0
EST.	699.9	21.9	4014.8	16569.7	0.0	48920.7	30536.8	6244.5	2852.7	214.0
DIFF.	384.9	21.9	834.2	23083.3	0.0	76.3	3087.8	1425.5	1402.7	68.0
DIF/ACT.	0.00	0.00	.17	.58	0.00	.00	.11	.30	.97	0.00
16 ACTUAL	135.0	0.0	1622.0	7793.0	48997.0	0.0	96272.0	15856.0	[illegible]	563.0
EST.	181.6	7.9	125.1	4373.6	48920.7	0.0	70948.4	12380.2	5282.5	193.1
DIFF.	46.6	7.9	1496.9	3419.4	76.3	0.0	25323.6	3475.8	1777.5	369.9
DIF/ACT.	0.00	0.00	.92	.44	.00	0.00	.27	.22	.51	.66
17 ACTUAL	170.0	0.0	1228.0	7575.0	27449.0	96272.0	0.0	86380.0	16120.0	2410.0
EST.	182.4	6.1	99.5	3524.9	30536.8	70948.4	0.0	80566.7	30689.0	1033.8
DIFF.	12.4	6.1	1128.5	4050.1	3087.8	25323.6	0.0	5813.3	14569.0	1376.2
DIF/ACT.	0.00	0.00	.92	.53	.11	.27	0.00	.07	.90	.57
18 ACTUAL	250.0	0.0	500.0	2169.0	4819.0	15856.0	86380.0	0.0	41923.0	4322.0
EST.	33.9	1.6	49.0	791.0	6244.5	12380.2	80566.7	0.0	44340.0	1342.7
DIFF.	216.1	1.6	451.0	1378.0	1425.5	3475.8	5813.3	0.0	2417.0	2979.3
DIF/ACT.	0.00	0.00	.90	.64	.30	.22	.07	0.00	.06	.69
19 ACTUAL	33.0	0.0	251.0	324.0	1450.0	3505.0	16120.0	41923.0	0.0	14160.0
EST.	15.5	.8	21.1	377.4	2852.7	5282.5	30689.0	44340.0	0.0	4867.4
DIFF.	76.5	.8	229.9	53.4	1402.7	1777.5	14569.0	2417.0	0.0	9292.6
DIF/ACT.	0.00	0.00	0.00	0.00	.97	.51	.90	.06	0.00	.66
20 ACTUAL	0.0	0.0	732.0	0.0	282.0	563.0	2410.0	4322.0	14160.0	0.0
EST.	1.1	.0	18.5	25.2	214.0	193.1	1033.8	1342.7	4867.4	0.0
DIFF.	1.1	.0	713.5	25.2	68.0	369.9	1376.2	2979.3	9292.6	0.0
DIF/ACT.	0.00	0.00	.97	0.00	0.00	.66	.57	.69	.66	0.00
21 ACTUAL	0.0	0.0	2294.0	598.0	2316.0	3296.0	12109.0	9990.0	5798.0	18281.0
EST.	18.4	.4	2440.5	320.0	6853.3	3633.5	13885.2	15254.7	7175.1	4709.2
DIFF.	18.4	.4	146.5	278.0	4537.3	337.5	1776.2	5264.7	1377.1	13571.8
DIF/ACT.	0.00	0.00	.06	.46	1.96	.10	.15	.53	.24	.74
22 ACTUAL	0.0	0.0	30.0	41.0	80.0	168.0	1176.0	273.0	1357.0	1481.0
EST.	1.6	.0	161.6	21.2	302.6	180.5	689.7	673.6	612.6	357.4
DIFF.	1.6	.0	131.6	19.8	222.6	12.5	486.3	400.6	744.4	1123.6
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	.41	0.00	.55	.76
23 ACTUAL	0.0	0.0	0.0	0.0	0.0	804.0	727.0	1060.0	1744.0	3763.0
EST.	2.5	.1	22.6	41.5	347.6	368.6	1567.1	1957.0	5722.0	7869.8
DIFF.	2.5	.1	22.6	41.5	347.6	435.4	840.1	897.0	3978.0	4106.8

	DIF/ACT.	0.30	0.00	0.00	0.30	0.00	.54	1.16	.85	2.28	1.09
24	ACTUAL	76.0	0.0	0.0	0.0	.0	55.0	139.0	0.0	0.0	223.0
	EST.	.4	.0	3.1	4.9	42.5	51.3	199.0	256.6	732.6	950.6
	DIFF.	75.6	.0	3.1	4.9	42.5	3.7	60.0	256.6	732.6	727.6
	DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	ACTUA.	0.0	0.0	0.0	0.0	21.0	26.0	419.0	448.0	327.0	0.0
	EST.	.5	.0	3.9	6.9	59.8	72.1	279.7	449.1	1029.7	839.8
	DIFF.	.5	.0	3.9	6.9	38.8	46.1	139.3	1.1	702.7	839.8
	DIF/ACT.	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	ACTUAL	0.0	0.0	0.0	84.0	58.0	28.0	186.0	0.0	0.0	0.0
	EST.	.0	.0	.1	.2	1.7	2.2	8.4	10.6	29.8	23.6
	DIFF.	.0	.0	.1	83.8	56.3	25.8	177.6	10.6	29.8	23.6
	DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	ACTUAL	0.0	0.0	0.0	0.0	40.0	0.0	0.0	0.0	43.0	51.0
	EST.	.0	.0	.0	.0	.5	.6	2.3	2.9	9.3	.8
	DIFF.	.0	.0	.0	.0	39.5	.6	2.3	2.9	33.7	50.2
	DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	ACTUA.	0.0	0.0	52.0	0.0	133.0	0.0	574.0	112.0	56.0	79.0
	EST.	.0	.0	.2	.9	10.1	11.9	46.2	59.6	193.6	22.2
	DIFF.	.0	.0	51.8	.9	122.9	11.9	627.8	52.4	137.6	56.8
	DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	.93	0.00	0.00	0.00
29	ACTUAL	0.0	0.0	0.0	0.0	59.0	62.0	188.0	209.0	299.0	0.0
	EST.	.2	.0	.8	3.8	32.6	54.4	219.4	284.2	943.3	91.1
	DIFF.	.2	.0	.8	3.8	26.4	7.6	31.4	75.2	643.3	91.1
	DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	ACTUAL	0.0	13.0	72.0	183.0	517.0	437.0	1553.0	1848.0	1362.0	495.0
	EST.	3.9	.1	11.3	44.2	403.0	628.7	2849.7	3553.8	10797.0	382.2
	DIFF.	3.9	12.9	60.7	138.8	114.0	191.7	1196.7	1705.8	9435.0	112.8
	DIF/ACT.	0.00	0.00	0.00	0.00	.22	0.00	.72	.92	6.93	0.00
TOTAL	ACTUAL	84457.0	8098.0	15934.0	78324.0	141408.0	191749.0	292551.0	195082.0	102423.0	48927.0
TOTAL	ESTIM.	107183.1	7177.3	16392.2	63683.4	135826.0	160737.6	283456.1	202619.4	131926.1	23576.0
	DIFFERENCE	27623.3	5099.7	12743.2	65061.2	46239.1	42308.4	76435.5	38376.8	51533.7	37101.3
	DIFF./ACTUAL	.33	.63	.80	.83	.33	.22	.26	.20	.50	.76

SUPERZONE		21	22	23	24	25	26	27	28	29	30
1	ACTUAL	3754.0	303.0	1374.0	38.0	140.0	47.0	248.0	356.0	2508.0	17724.0
	EST.	1420.6	123.5	304.5	35.1	49.3	2.1	2.8	56.7	288.5	9111.3
	DIFF.	3333.4	179.5	1064.5	2.9	90.7	44.9	245.2	299.3	2219.5	8612.7
	DIF/ACT.	.68	0.00	.77	0.00	0.00	0.00	0.00	0.00	.88	.49
2	ACTUAL	563.0	137.0	775.0	114.0	0.0	164.0	266.0	117.0	483.0	8587.0
	EST.	1147.9	80.1	226.5	32.5	83.6	2.4	6.8	142.7	693.5	17438.4
	DIFF.	584.3	56.9	544.4	81.6	83.6	161.6	259.2	26.7	210.5	8851.4
	DIF/ACT.	1.04	0.00	.71	0.00	0.00	0.00	0.00	0.00	0.00	1.03

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3 ACTUAL	1882.0	74.0	564.0	0.0	144.0	23.0	68.0	687.0	544.0	4032.0
EST.	1559.1	108.8	303.9	40.5	56.9	2.4	1.6	31.5	148.5	3777.5
DIFF.	322.9	34.8	260.1	40.5	86.1	20.6	66.4	655.5	395.5	254.5
DIF/ACT.	.17	0.00	.47	0.00	0.00	0.00	0.00	.95	.73	.06
4 ACTUAL	146.0	0.0	320.0	0.0	0.0	0.0	48.0	140.0	170.0	2555.0
EST.	767.8	54.7	163.7	24.8	59.8	1.8	4.1	84.1	391.7	8866.3
DIFF.	621.8	54.7	155.3	24.8	59.8	1.8	43.9	55.9	221.7	6311.3
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.47
5 ACTUAL	875.0	35.0	142.0	54.0	25.0	0.0	399.0	74.0	380.0	1596.0
EST.	512.9	36.5	105.8	15.2	32.1	1.0	1.5	31.0	144.2	1397.8
DIFF.	363.1	1.5	36.2	38.8	7.1	1.0	397.5	43.0	235.8	198.2
DIF/ACT.	.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.12
6 ACTUAL	249.0	40.0	39.0	0.0	0.0	0.0	62.0	0.0	0.0	728.0
EST.	233.4	15.8	45.0	5.6	7.9	.2	.2	4.1	13.5	530.2
DIFF.	15.6	24.2	6.0	5.6	7.9	.2	61.8	4.1	13.5	197.8
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.27
7 ACTUAL	341.0	0.0	83.0	0.0	0.0	23.0	96.0	0.0	0.0	476.0
EST.	41.5	3.4	9.4	1.1	1.0	.0	.0	.0	3.6	99.6
DIFF.	299.5	3.4	73.6	1.1	1.0	23.0	96.0	.8	3.6	376.4
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8 ACTUAL	148.0	0.0	85.0	34.0	0.0	86.0	104.0	0.0	0.0	78.0
EST.	25.4	2.1	3.1	.4	.5	.8	.0	.3	1.2	32.7
DIFF.	122.6	2.1	81.9	33.6	.5	88.0	104.0	.3	1.2	45.3
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9 ACTUAL	533.0	40.0	0.0	0.0	0.0	0.0	224.0	0.0	0.0	116.0
EST.	140.3	14.3	10.1	1.2	1.6	.1	.0	.2	.8	21.9
DIFF.	392.7	25.7	10.1	1.2	1.6	.1	224.0	.2	.8	94.1
DIF/ACT.	.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10 ACTUAL	137.0	0.0	124.0	93.0	0.0	0.0	0.0	0.0	153.0	30.0
EST.	6.0	.5	1.0	.1	.2	.0	.0	.0	.1	1.7
DIFF.	131.0	.5	123.0	92.9	.2	.0	.0	.0	152.9	28.3
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11 ACTUAL	0.0	0.0	0.0	76.0	0.0	0.0	0.0	0.0	0.0	0.0
EST.	18.4	1.0	2.5	.4	.5	.0	.0	.0	.2	3.9
DIFF.	18.4	1.0	2.5	75.6	.5	.0	.0	.0	.2	3.9
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12 ACTUAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0
EST.	.4	.0	.1	.0	.0	.0	.0	.0	.0	.1
DIFF.	.4	.0	.1	.0	.0	.0	.0	.0	.0	12.9
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13 ACTUAL	2234.0	30.0	0.0	0.0	0.0	0.0	0.0	52.0	0.0	72.0
EST.	2440.5	161.6	22.5	9.1	3.9	.1	.0	.2	.8	11.3
DIFF.	146.5	131.6	22.5	9.1	3.9	.1	.0	51.8	.8	60.7
DIF/ACT.	.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14 ACTUAL	899.0	41.0	0.0	0.0	0.0	84.0	0.0	0.0	0.0	183.0

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EST.	320.0	21.2	41.5	4.9	6.9	.2	.0	.9	3.8	44.2
DIFF.	678.0	19.8	41.5	4.9	6.9	83.8	.0	.9	3.8	138.8
DIF/ACT.	.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15 ACTUAL	2316.0	30.0	0.0	0.0	21.0	58.0	40.0	133.0	59.0	517.0
EST.	6853.3	302.6	347.5	42.5	59.8	1.7	.5	10.1	32.6	403.0
DIFF.	4537.3	222.6	347.6	42.5	38.8	56.3	39.5	122.9	26.4	114.0
DIF/ACT.	1.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.22
16 ACTUAL	3295.0	158.0	804.0	55.0	26.0	28.0	0.0	0.0	62.0	437.0
EST.	3633.5	180.5	368.6	51.3	72.1	2.2	.6	11.9	54.4	628.7
DIFF.	337.5	12.5	435.4	3.7	46.1	25.8	.6	11.9	7.6	191.7
DIF/ACT.	.10	0.00	.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 ACTUAL	12109.0	1176.0	727.0	139.0	419.0	186.0	0.0	674.0	188.0	1659.0
EST.	13885.2	689.7	1567.1	199.0	279.7	8.4	2.3	46.2	219.4	2849.7
DIFF.	1776.2	486.3	840.1	60.0	139.3	177.6	2.3	627.8	31.4	1190.7
DIF/ACT.	.15	.41	1.16	0.00	0.00	0.00	0.00	.93	0.00	.72
18 ACTUAL	9940.0	273.0	1060.0	0.0	448.0	0.0	0.0	112.0	203.0	1848.0
EST.	15254.7	673.6	1957.0	256.6	449.1	10.6	2.9	59.6	284.2	3553.8
DIFF.	5254.7	400.6	897.0	256.6	1.1	10.6	2.9	52.4	75.2	1705.8
DIF/ACT.	.53	0.00	.85	0.00	0.00	0.00	0.00	0.00	0.00	.92
19 ACTUAL	5798.0	1357.0	1744.0	0.0	327.0	0.0	43.0	56.0	299.0	1362.0
EST.	7175.1	612.6	6722.0	732.6	1029.7	29.8	9.3	193.6	948.3	10797.0
DIFF.	1377.1	744.4	3978.0	732.6	702.7	29.8	33.7	137.6	649.3	9435.0
DIF/ACT.	.24	.55	2.28	0.00	0.00	0.00	0.00	0.00	0.00	6.93
20 ACTUAL	18281.0	1481.0	3703.0	223.0	0.0	0.0	51.0	79.0	0.0	495.0
EST.	4709.2	357.4	7603.8	950.6	839.8	23.6	.8	22.2	91.1	382.2
DIFF.	13571.8	1123.6	4535.8	727.6	839.8	23.6	50.2	56.8	91.1	112.8
DIF/ACT.	.74	.76	1.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21 ACTUAL	0.0	13582.0	2264.0	194.0	308.0	0.0	0.0	28.0	18.0	366.0
EST.	0.0	29137.7	5201.3	2155.4	745.7	21.2	.7	7.4	43.1	579.9
DIFF.	0.0	15515.7	2937.3	1971.4	437.7	21.2	.7	20.6	25.1	213.9
DIF/ACT.	0.00	1.13	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22 ACTUAL	13682.0	0.0	430.0	35.0	153.0	0.0	0.0	0.0	80.0	171.0
EST.	23137.7	0.0	591.3	246.4	84.8	1.8	.1	1.1	4.9	56.6
DIFF.	15515.7	0.0	161.9	211.4	68.2	1.8	.1	1.1	75.1	114.4
DIF/ACT.	1.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23 ACTUAL	2254.0	430.0	0.0	4522.0	9376.0	310.0	0.0	229.0	871.0	858.0
EST.	5201.3	591.9	0.0	10357.0	8459.2	193.7	5.8	66.9	399.5	549.7
DIFF.	2382.3	161.9	0.0	5835.0	916.8	116.3	5.8	162.1	471.5	308.3
DIF/ACT.	1.30	0.00	0.00	1.29	.10	0.00	0.00	0.00	.54	.36
24 ACTUAL	134.0	35.0	4522.0	0.0	2316.0	23.0	160.0	0.0	39.0	242.0
EST.	2165.4	246.4	10357.0	0.0	2543.8	75.3	2.3	25.1	44.0	64.4
DIFF.	1371.4	211.4	5835.0	0.0	327.8	52.3	157.7	25.1	5.0	177.6
DIF/ACT.	0.00	0.00	1.29	0.00	.13	0.00	0.00	0.00	0.00	0.00
25 ACTUAL	308.0	153.0	9375.0	2516.0	0.0	2706.0	0.0	186.0	1491.0	91.0
EST.	745.7	84.8	8459.2	2343.8	0.0	2351.6	59.7	785.3	238.0	282.1
DIFF.	437.7	68.2	915.8	327.8	0.0	356.4	59.7	597.3	1253.0	191.1

Appendix A,
Attachment 4

DIF/ACT.	0.00	0.00	.10	.13	0.00	.13	0.00	0.00	.84	0.00
26 ACTUAL	0.0	0.0	310.0	23.0	2708.0	0.0	70.0	376.0	0.0	200.0
EST.	21.2	1.8	193.7	75.3	2351.6	0.0	172.4	1006.8	103.4	3.9
DIFF.	21.2	1.8	115.3	52.3	356.4	0.0	102.4	630.8	103.4	196.1
DIF/ACT.	0.00	0.00	0.00	0.00	.13	0.00	0.00	0.00	0.00	0.00
27 ACTUAL	0.0	0.0	0.0	160.0	0.0	70.0	0.0	14320.0	7144.0	44.0
EST.	.7	.1	5.9	2.3	59.7	172.4	0.0	11801.5	824.8	32.7
DIFF.	.7	.1	5.8	157.7	59.7	102.4	0.0	2518.5	6319.2	11.3
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.18	.88	0.00
28 ACTUAL	29.0	0.0	223.0	0.0	188.0	370.0	14320.0	0.0	11917.0	949.0
EST.	2.4	1.1	60.9	25.1	785.3	1006.8	11801.5	0.0	22505.2	783.1
DIFF.	26.5	1.1	162.1	25.1	597.3	630.8	2518.5	0.0	10533.2	165.9
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	.18	0.00	.89	.17
29 ACTUAL	16.0	80.0	871.0	39.0	1491.0	0.0	7144.0	11917.0	0.0	11720.0
EST.	43.1	4.9	399.5	44.0	236.0	103.4	824.8	22505.2	0.0	5043.7
DIFF.	25.8	75.1	471.5	5.0	1255.0	103.4	6319.2	10588.2	0.0	6676.3
DIF/ACT.	0.00	0.00	.54	0.00	.84	0.00	.88	.89	0.00	.57
30 ACTUAL	366.0	171.0	659.0	242.0	91.0	200.0	44.0	949.0	11720.0	0.0
EST.	579.9	56.6	963.7	64.4	282.1	3.9	32.7	783.1	5043.7	0.0
DIFF.	213.9	114.4	305.3	177.6	191.1	196.1	11.3	165.9	6670.3	0.0
DIF/ACT.	0.00	0.00	.36	0.00	0.00	0.00	0.00	.17	.57	0.00
TOTAL ACTUAL	82671.0	19786.0	30466.0	8557.0	18380.0	4344.0	23387.0	30487.0	38335.0	57349.0
TOTAL ESTIM.	99507.6	35525.8	44900.8	18227.2	18885.3	4016.8	12333.5	37678.2	32532.9	67347.4
DIFFERENCE	55539.0	19675.9	23949.4	11008.9	6325.2	2329.3	10802.6	16856.5	29863.3	45991.3
DIFF./ACTUA.	.67	.99	.73	3.28	.36	.53	.46	.56	.78	.80

TOTAL ACTUAL DEMAND, ALL SUPERZONES 3308474

SUM OF ABSOLUTE DIFFERENCES 1332983

TRAVEL ESTIMATES

USING α OF 0.05

Appendix A,
Attachment 5

ACTUAL AND ESTIMATED DEMAND
ALPHA= .050

SUPERZONE	1	2	3	4	5	6	7	8	9	10
1 ACTUAL	0.0	39334.0	50597.0	55534.0	27163.0	13838.0	6329.0	1897.0	3250.0	809.0
EST.	0.0	61577.2	45597.7	47254.3	22249.5	3257.6	729.0	289.6	178.8	26.1
DIFF.	0.0	37816.8	4999.3	8279.7	4913.5	10640.4	5600.0	1607.4	3071.2	782.9
DIF/ACT.	0.10	.38	.10	.15	.18	.77	.88	.85	.94	.97
2 ACTUAL	93394.0	0.0	31885.0	45125.0	12913.0	4552.0	1562.0	1308.0	744.0	0.0
EST.	51577.2	0.0	20659.1	83957.2	24537.3	3936.6	989.7	415.8	250.7	33.0
DIFF.	37816.8	0.0	11225.9	38832.2	11624.3	585.4	572.3	892.2	493.3	33.0
DIF/ACT.	.38	0.00	.35	.86	.30	.13	.37	.68	.66	0.00
3 ACTUAL	50597.0	31885.0	0.0	44478.0	30982.0	8177.0	1793.0	1687.0	2272.0	951.0
EST.	45597.7	20659.1	0.0	42917.3	34458.2	8315.5	1885.4	749.0	441.9	55.8
DIFF.	4939.3	11225.9	0.0	1560.7	3476.2	138.5	92.4	938.0	1830.1	835.2
DIF/ACT.	.10	.35	0.00	.04	.11	.02	.05	.56	.81	.94
4 ACTUAL	55534.0	45125.0	44478.0	0.0	27213.0	3574.0	1220.0	421.0	635.0	0.0
EST.	47254.3	83957.2	42817.3	0.0	58158.1	8815.2	2156.5	887.8	515.9	68.5
DIFF.	8279.7	38832.2	1660.7	0.0	30945.1	5241.2	936.5	466.8	119.1	68.5
DIF/ACT.	.15	.86	.04	0.00	1.14	1.47	.77	0.00	.19	0.00
5 ACTUAL	27163.0	12913.0	30982.0	27213.0	0.0	37859.0	7501.0	3444.0	3563.0	1021.0
EST.	22249.5	24537.3	34458.2	58158.1	0.0	32082.1	6822.0	2606.6	1460.3	185.9
DIFF.	4913.5	11624.3	3476.2	30945.1	0.0	5776.9	779.0	837.4	2102.7	835.1
DIF/ACT.	.18	.90	.11	1.14	0.00	.15	.10	.24	.59	.82
6 ACTUAL	13838.0	4552.0	8177.0	3574.0	37859.0	0.0	40331.0	5445.0	6095.0	1142.0
EST.	3257.6	3966.6	8315.5	8815.2	32082.1	0.0	40915.4	13518.2	7183.3	844.5
DIFF.	10580.4	585.4	138.5	5241.2	5776.9	0.0	584.4	8073.2	1088.3	297.5
DIF/ACT.	.77	.13	.02	1.47	.15	0.00	.01	1.48	.18	.26
7 ACTUAL	6329.0	1562.0	1793.0	1220.0	7501.0	40331.0	0.0	50303.0	17730.0	2710.0
EST.	729.0	989.7	1885.4	2156.5	6322.0	40915.4	0.0	35278.1	16881.3	1780.0
DIFF.	5600.0	572.3	92.4	935.5	779.0	584.4	0.0	15024.9	854.7	930.0
DIF/ACT.	.18	.37	.05	.77	.10	.01	0.00	.30	.05	
8 ACTUAL	1897.0	1308.0	1687.0	421.0	3444.0	5445.0	50303.0	0.0	92336.0	104[illegible]
EST.	283.6	415.8	749.0	887.8	2606.6	13518.2	35278.1	0.0	7968[illegible]	7278.5
DIFF.	1607.4	892.2	938.0	466.8	837.4	8073.2	15024.9	0.0	1265[illegible]	3202.2
DIF/ACT.	.65	.68	.56	0.00	.24	1.48	.30	0.00	4	.31
9 ACTUAL	3250.0	744.0	2272.0	635.0	3563.0	5035.0	17736.0	92336.0	0.0	126754.0
EST.	178.8	250.7	441.9	515.9	1460.3	7183.3	16881.3	79680.0	0.0	83339.1
DIFF.	3071.2	493.3	1830.1	119.1	2102.7	1088.3	854.7	12656.0	0.0	43414.9
DIF/ACT.	.94	.66	.81	.19	.59	.18	.05	.14	0.00	.34
1C ACTUAL	809.0	0.0	951.0	0.0	1021.0	1142.0	2710.0	10481.0	126754.0	0.0
EST.	26.1	33.0	55.8	68.5	185.9	844.5	1780.0	7278.8	83339.1	0.0

Appendix A,
Attachment 5

DIFF.	782.9	33.0	895.2	68.5	835.1	237.5	930.0	3202.2	43414.9	0.0
DIF/ACT.	.37	0.00	.94	0.04	.82	.26	.34	.31	.34	0.00
11 ACTUAL	125.0	220.0	308.0	0.0	1021.0	1183.0	2072.0	8341.0	53540.0	13185.0
EST.	36.1	42.7	77.4	80.3	228.7	1181.5	2349.2	12533.3	83773.0	27223.5
DIFF.	89.9	177.3	230.5	80.3	792.3	1.5	777.2	4192.3	30227.0	14038.5
DIF/ACT.	0.30	0.00	0.00	0.00	.78	.00	.38	.50	.56	1.06
12 ACTUAL	13.0	83.0	0.0	0.0	296.0	0.0	0.0	377.0	4000.0	2267.0
EST.	.7	1.2	2.0	2.5	6.6	28.2	54.6	203.7	1264.6	3331.4
DIFF.	12.3	81.8	2.0	2.5	289.4	28.2	54.6	173.3	2735.4	1064.4
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.68	.47
13 ACTUAL	303.0	52.0	437.0	110.0	271.0	83.0	152.0	253.0	127.0	149.0
EST.	53.5	44.0	54.4	30.4	32.8	163.3	350.0	209.9	898.1	134.8
DIFF.	249.5	8.0	382.6	85.6	238.2	74.3	198.0	43.1	771.1	14.2
DIF/ACT.	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14 ACTUAL	528.0	326.0	1547.0	783.0	1363.0	1236.0	1627.0	3181.0	3810.0	963.0
EST.	301.5	215.9	147.2	186.6	521.1	3614.9	8301.9	3235.3	17191.5	2640.4
DIFF.	226.5	110.1	1399.8	596.4	841.9	2318.9	6674.9	54.3	13381.5	1677.4
DIF/ACT.	.43	0.00	.90	.76	.62	1.79	4.10	.02	3.51	1.74
15 ACTUAL	2928.0	707.0	2165.0	249.0	655.0	1077.0	571.0	456.0	1171.0	288.0
EST.	2282.5	1486.2	1905.8	1239.3	1509.8	4346.7	2753.4	1140.5	3740.3	641.2
DIFF.	645.5	779.2	262.2	1050.3	[illegible]	3269.7	2182.4	684.5	2569.0	353.2
DIF/ACT.	.22	1.10	.12	0.30	1.31	3.50	3.10	0.00	2.19	0.00
16 ACTUAL	4371.0	2307.0	2278.0	528.0	613.0	484.0	139.0	208.0	510.0	86.0
EST.	4307.1	2741.9	3510.0	1765.5	1394.1	2073.7	1223.5	520.5	1594.6	257.5
DIFF.	53.9	434.9	1232.0	1237.5	781.1	1589.7	1084.5	312.5	1078.6	171.5
DIF/ACT.	.01	.19	.54	2.34	1.27	0.00	0.00	0.00	2.09	0.00
17 ACTUAL	15524.0	4803.0	7275.0	3732.0	2515.0	1095.0	386.0	572.0	971.0	196.0
EST.	15158.1	9830.3	12601.4	5141.5	4161.2	1597.9	972.1	422.7	1232.5	199.3
DIFF.	634.1	5027.3	5326.4	2409.5	1946.2	502.9	586.1	149.3	261.5	3.3
DIF/ACT.	.04	1.05	.73	.65	.59	.46	0.00	.26	.27	0.00
18 ACTUAL	12735.0	3087.0	3824.0	1732.0	1544.0	483.0	519.0	134.0	641.0	224.0
EST.	12363.8	7303.8	9445.4	4501.5	3071.1	970.4	283.0	125.9	353.0	57.7
DIFF.	371.2	4216.8	5622.4	2769.5	1527.1	487.4	236.0	8.1	288.0	166.3
DIF/ACT.	.03	1.37	1.47	1.60	.99	0.00	.45	0.00	.45	0.00
19 ACTUAL	5584.0	1106.0	4358.0	728.0	879.0	423.0	24.0	0.0	428.0	76.0
EST.	5676.9	3322.6	4364.9	2055.4	1419.9	471.7	143.4	65.4	177.4	29.5
DIFF.	92.9	2216.6	6.9	1327.4	540.9	48.7	119.4	65.4	250.6	46.5
DIF/ACT.	.01	2.00	.00	1.82	.62	0.00	0.00	0.00	0.00	0.00
20 ACTUAL	1012.0	248.0	440.0	39.0	298.0	0.0	48.0	0.0	0.0	0.0
EST.	402.0	320.6	388.4	227.6	148.3	64.6	16.3	6.7	20.0	3.0
DIFF.	610.0	72.6	51.6	188.6	149.7	64.6	31.7	6.7	20.0	3.0
DIF/ACT.	.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21 ACTUAL	5754.0	553.0	1882.0	146.0	876.0	249.0	341.0	148.0	533.0	137.0
EST.	1753.3	1159.9	1477.1	768.8	515.1	254.1	62.4	47.2	209.9	16.7
DIFF.	4000.7	606.9	404.9	622.8	360.9	5.1	278.6	100.8	323.1	120.3
DIF/ACT.	.70	1.08	.22	0.00	.41	0.00	0.00	0.00	.61	0.00

Appendix A,
Attachment 5

22 ACTUAL	303.0	137.0	[illegible]	0.0	35.0	40.0	0.0	0.0	40.0	0.0
EST.	132.3	88.5	112.6	58.7	39.6	18.9	5.6	4.3	23.8	1.6
DIFF.	170.7	48.5	39.6	59.7	4.6	21.1	5.6	4.3	16.2	1.6
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23 ACTUAL	1374.0	775.0	564.0	320.0	142.0	39.0	83.0	85.0	0.0	124.0
EST.	303.9	232.7	288.8	166.2	110.0	51.6	14.2	6.2	17.0	2.7
DIFF.	1070.1	542.3	275.2	153.8	32.0	12.6	68.8	78.8	17.0	121.3
DIF/ACT.	.78	.70	.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24 ACTUAL	38.0	114.0	0.0	0.0	64.0	0.0	0.0	34.0	0.0	93.0
EST.	24.7	20.3	24.9	14.9	9.8	4.3	1.2	.5	1.4	.2
DIFF.	13.3	93.7	24.8	14.9	54.2	4.3	1.2	33.6	1.4	92.8
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25 ACTUAL	140.0	0.0	143.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0
EST.	52.6	91.0	59.5	65.5	36.7	10.2	2.5	1.0	2.9	.4
DIFF.	87.4	91.0	84.5	65.5	11.7	10.2	2.5	1.0	2.9	.4
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26 ACTUAL	47.0	154.0	23.0	0.0	0.0	0.0	23.0	88.0	0.0	0.0
EST.	4.0	4.9	9.5	3.7	2.1	.6	.1	.1	.2	.0
DIFF.	43.0	159.1	13.5	3.7	2.1	.6	22.9	87.9	.2	.0
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27 ACTUAL	248.0	266.0	69.0	48.0	399.0	62.0	96.0	104.0	224.0	0.0
EST.	8.9	23.0	5.7	14.7	5.9	.9	.2	.1	.1	.0
DIFF.	239.1	243.0	62.3	33.3	393.1	61.1	95.8	103.9	223.9	.0
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 ACTUAL	356.0	117.0	687.0	140.0	74.0	0.0	0.0	0.0	0.0	0.0
EST.	59.0	155.7	43.2	100.9	40.4	6.4	1.5	.6	.4	.0
DIFF.	297.0	48.7	643.8	39.1	33.6	6.4	1.5	.6	.4	.0
DIF/ACT.	0.00	0.00	.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29 ACTUAL	2508.0	493.0	544.0	170.0	380.0	0.0	0.0	0.0	0.0	153.0
EST.	407.6	1007.6	232.8	590.6	234.0	30.4	8.2	3.3	2.2	.3
DIFF.	2100.4	524.6	311.2	420.6	146.0	30.4	8.2	3.3	2.2	152.7
DIF/ACT.	.84	0.00	.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30 ACTUAL	17724.9	8597.0	4032.0	2555.0	1596.0	728.0	476.0	78.0	116.0	30.0
EST.	7162.8	13586.5	3176.0	5926.9	1244.7	491.9	128.7	56.5	36.1	4.9
DIFF.	10561.2	4339.5	855.0	4371.9	351.3	236.1	347.3	21.5	79.3	25.1
DIF/ACT.	.60	.53	.21	1.71	.22	.32	0.00	0.00	0.00	0.00
TOTAL ACTUAL	330503.0	221528.0	203475.0	183430.0	164365.0	123321.0	136242.0	181381.0	319508.0	161039.0
TOTAL ESTIM.	232667.2	236085.3	132895.7	269538.3	137291.9	134786.6	124609.6	159287.5	300470.8	128156.8
DIFFERENCE	93253.3	122557.3	42494.3	102087.8	70241.6	41705.6	38051.2	49823.5	117381.3	68511.3
DIFF./ACTUAL	.30	.55	.21	.54	.43	.33	.28	.27	.37	.42
SUPERZONE	11	12	13	14	15	16	17	18	19	20

Appendix A, Attachment 5

1	ACTUAL	125.0	13.0	303.0	528.0	2928.0	4371.0	15524.0	12735.0	5594.0	1012.0
	EST.	31.1	.7	59.5	301.5	2282.5	4307.1	16158.1	12363.8	5676.3	402.0
	DIFF.	93.9	12.3	243.5	226.5	645.5	63.9	634.1	371.2	82.9	610.0
	DIF/ACT.	0.10	0.00	0.00	.43	.22	.01	.04	.03	.01	.60
2	ACTUAL	220.0	93.0	52.0	326.0	707.0	2307.0	4803.0	3087.0	1106.0	248.0
	EST.	42.7	1.2	44.0	215.9	1486.2	2741.9	9830.3	7303.8	3322.6	320.6
	DIFF.	177.3	91.8	8.0	110.1	779.2	434.9	5027.3	4216.8	2216.6	72.6
	DIF/ACT.	0.80	0.00	0.00	0.00	1.10	.19	1.05	1.37	2.00	0.00
3	ACTUAL	308.0	0.0	437.0	1547.0	2168.0	2273.0	7276.0	3826.0	4358.0	440.0
	EST.	77.4	2.0	54.4	147.2	1905.8	3510.0	12601.4	9446.4	4364.9	388.4
	DIFF.	230.6	2.0	382.5	1393.8	262.2	1232.0	5325.4	5622.4	6.9	51.6
	DIF/ACT.	[illegible]	0.00	0.00	[illegible]	.12	.54	.73	1.47	.00	0.00
4	ACTUAL	0.0	0.0	156.0	783.0	249.0	528.0	3732.0	1732.0	728.0	39.0
	EST.	90.3	2.5	70.5	186.6	1299.3	1765.5	6141.5	4501.5	2055.4	227.6
	DIFF.	90.3	2.5	85.5	596.4	1050.3	1237.5	2409.5	2769.5	1327.4	188.6
	DIF/ACT.	0.30	0.00	0.00	.76	0.00	2.34	.65	1.60	1.82	0.00
5	ACTUAL	1921.0	296.0	271.0	1363.0	655.0	613.0	2615.0	1544.0	879.0	298.0
	EST.	228.7	6.6	32.8	521.1	1509.8	1394.1	4161.2	3071.1	1419.9	148.3
	DIFF.	1692.3	289.4	238.2	841.9	854.8	781.1	1546.2	1527.1	540.9	149.7
	DIF/ACT.	.78	0.00	0.00	[illegible]	1.31	1.27	.59	.39	.62	0.00
6	ACTUAL	1183.0	0.0	89.0	1296.0	1077.0	484.0	1095.0	483.0	421.0	0.0
	EST.	1181.5	28.2	163.3	3614.9	4846.7	2073.7	1597.9	970.4	471.7	64.6
	DIFF.	1.5	28.2	74.3	2318.9	3769.7	1589.7	502.9	487.4	48.7	64.6
	DIF/ACT.	.10	0.00	0.00	1.79	3.50	0.00	.46	0.00	0.00	0.00
7	ACTUAL	2072.0	0.0	352.0	1627.0	671.0	139.0	386.0	519.0	24.0	48.0
	EST.	2849.2	54.6	[illegible]	8301.9	2753.4	1223.5	972.1	283.0	143.4	16.3
	DIFF.	777.2	54.6	195.0	6674.9	2082.4	1084.5	586.1	236.0	119.4	31.7
	DIF/ACT.	.38	0.00	0.00	4.10	3.10	0.00	0.00	.45	0.00	0.00
8	ACTUAL	8341.0	377.0	253.0	3181.0	456.0	208.0	572.0	134.0	0.0	0.0
	EST.	12533.3	203.7	209.9	3235.3	1140.5	520.5	422.7	125.9	65.4	6.7
	DIFF.	4192.3	173.3	43.1	54.3	684.5	312.5	149.3	8.1	65.4	6.7
	DIF/ACT.	.50	0.00	0.00	.02	0.00	0.00	.26	0.00	0.00	0.00
9	ACTUAL	53546.0	4000.0	127.0	3810.0	1171.0	516.0	971.0	641.0	424.0	0.0
	EST.	83773.0	1264.6	898.1	17191.5	3740.9	1594.6	1232.5	353.0	177.4	20.0
	DIFF.	30227.0	2735.4	771.1	13381.5	2569.9	1078.6	261.5	288.0	250.6	20.0
	DIF/ACT.	.56	.68	0.00	3.51	2.19	2.09	.27	.45	0.00	0.00
10	ACTUAL	13185.0	2257.0	149.0	363.0	288.0	86.0	196.0	224.0	76.0	0.0
	EST.	27223.5	3331.4	134.8	2040.4	641.2	257.5	199.3	57.7	29.5	3.0
	DIFF.	14038.5	1064.4	14.2	1677.4	353.2	171.5	3.3	166.3	46.5	3.0
	DIF/ACT.	1.06	.47	0.00	1.74	0.00	0.00	0.00	0.00	0.00	0.00
11	ACTUAL	0.0	1049.0	293.0	2069.0	315.0	135.0	170.0	250.0	93.0	0.0
	EST.	0.0	917.8	305.1	5586.8	1235.7	468.3	346.2	83.9	39.6	5.3
	DIFF.	0.0	131.2	7.1	3517.8	920.7	333.3	176.2	166.1	53.6	5.3
	DIF/ACT.	0.00	.13	0.00	1.70	0.00	0.00	0.00	0.00	0.00	0.00
12	ACTUAL	1043.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0
	EST.	917.8	0.0	4.8	96.4	24.1	9.7	7.5	2.2	1.1	.1

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	DIFF.	131.2	0.0	4.8	96.4	24.1	9.7	7.5	2.2	1.1	.1
	DIF/ACT.	.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	ACTUAL	238.0	0.0	0.0	2111.0	4849.0	1622.0	1228.0	500.0	251.0	732.0
	EST.	305.1	4.8	0.0	5853.3	3236.5	153.8	114.1	63.3	27.1	35.5
	DIFF.	7.1	4.8	0.0	3742.3	1612.5	1468.2	1113.9	436.7	223.9	696.5
	DIF/ACT.	0.00	0.00	0.00	1.77	.33	.91	.91	.87	0.00	.95
14	ACTUAL	2069.0	0.0	2111.0	0.0	39653.0	7793.0	7575.0	2169.0	324.0	0.0
	EST.	5586.8	36.4	5853.3	0.0	17615.1	5919.0	4110.7	1087.1	511.1	72.3
	DIFF.	3517.8	36.4	3742.3	0.0	22037.9	1874.0	3464.3	1081.9	187.1	72.3
	DIF/ACT.	1.70	0.00	1.77	0.00	.56	.24	.46	.50	0.00	0.00
15	ACTUAL	315.0	0.0	4844.0	39653.0	0.0	48337.0	27449.0	4819.0	1450.0	282.0
	EST.	1235.7	24.1	3236.5	17615.1	0.0	56608.8	29694.9	7283.7	3227.8	561.4
	DIFF.	920.7	24.1	1612.5	22037.9	0.0	7611.8	2245.9	2464.7	1777.8	279.4
	DIF/ACT.	0.00	0.00	.33	.56	0.00	.16	.08	.51	1.23	0.00
16	ACTUAL	135.0	0.0	1622.0	7793.0	48997.0	0.0	96872.0	15856.0	3505.0	563.0
	EST.	468.3	9.7	153.8	5919.0	56603.8	0.0	78001.1	17020.5	7081.4	586.7
	DIFF.	333.3	9.7	1468.2	1874.0	7611.8	0.0	18870.9	1164.5	3576.4	23.7
	DIF/ACT.	0.00	0.00	.91	.24	.15	0.00	.19	.07	1.02	.04
17	ACTUAL	170.0	0.0	1228.0	7575.0	27449.0	96872.0	0.0	86380.0	16120.0	2410.0
	EST.	346.2	7.5	114.1	4110.7	29694.9	78001.1	0.0	76326.7	28195.1	2203.5
	DIFF.	176.2	7.5	1113.9	3464.3	2245.9	18870.9	0.0	10053.3	12075.1	206.5
	DIF/ACT.	0.00	0.00	.91	.46	.08	.19	0.00	.12	.75	.09
18	ACTUAL	250.0	0.0	500.0	2169.0	4819.0	15856.0	86380.0	0.0	41923.0	4322.0
	EST.	83.9	2.2	63.3	1087.1	7283.7	17020.5	76326.7	0.0	43225.4	3125.2
	DIFF.	166.1	2.2	436.7	1081.9	2464.7	1164.5	10053.3	0.0	1302.4	1196.8
	DIF/ACT.	0.00	0.00	.87	.50	.51	.07	.12	0.00	.03	.28
19	ACTUAL	93.0	0.0	251.0	324.0	1450.0	3505.0	16120.0	41923.0	0.0	14160.0
	EST.	39.6	1.1	27.1	511.1	3227.8	7081.4	28195.1	43225.4	0.0	9881.1
	DIFF.	53.4	1.1	223.9	187.1	1777.8	3576.4	12075.1	1302.4	0.0	4278.9
	DIF/ACT.	0.00	0.00	0.00	0.00	1.23	1.02	.75	.03	0.00	.30
20	ACTUAL	0.0	0.0	732.0	0.0	282.0	563.0	2410.0	4322.0	14160.0	0.0
	EST.	5.9	.1	35.5	72.3	561.4	586.7	2203.5	3125.2	9881.1	0.0
	DIFF.	5.9	.1	696.5	72.3	279.4	23.7	206.5	1196.8	4278.9	0.0
	DIF/ACT.	0.00	0.00	.95	0.00	0.00	.04	.09	.28	.30	0.00
21	ACTUAL	0.0	0.0	2294.0	934.0	2316.0	3296.0	12103.0	9990.0	5794.0	18281.0
	EST.	32.1	.6	1904.7	397.5	6344.0	3836.9	11491.5	13013.5	5854.0	6620.2
	DIFF.	32.1	.6	389.3	500.5	4028.0	540.9	517.5	3023.5	56.0	11660.8
	DIF/ACT.	0.00	0.00	.17	.56	1.74	.16	.05	.30	.01	.64
22	ACTUAL	0.0	0.0	30.0	41.0	80.0	168.0	1176.0	273.0	1357.0	1481.0
	EST.	3.2	.1	143.1	23.7	312.8	213.0	537.4	639.3	521.4	542.8
	DIFF.	3.2	.1	113.1	11.3	232.8	45.0	538.6	366.3	835.6	938.2
	DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	.46	0.00	.62	.63
23	ACTUAL	0.0	0.0	0.0	0.0	0.0	804.0	727.0	1060.0	1744.0	3763.0
	EST.	4.5	.1	24.2	53.4	361.3	394.3	1351.3	1657.0	4110.0	8163.0
	DIFF.	4.5	.1	24.2	53.4	361.3	409.7	624.3	597.0	2366.0	4400.0
	DIF/ACT.	0.00	0.00	0.00	0.00	0.00	.51	.86	.56	1.36	1.17

Appendix A,
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24 ACTUAL	75.0	0.0	0.0	0.0	4.0	55.0	139.0	0.0	0.0	223.0
EST.	.4	.0	5.4	4.2	21.6	33.0	111.6	135.1	330.0	580.4
DIFF.	75.0	.0	5.4	4.2	28.4	22.0	27.4	135.1	330.0	357.4
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25 ACTUAL	0.0	0.0	0.0	0.0	21.0	26.0	419.0	446.0	327.0	0.0
EST.	.9	.0	4.8	3.5	67.3	78.0	264.1	395.9	818.2	777.6
DIFF.	.9	.0	4.8	3.5	46.3	52.0	154.9	52.1	491.2	777.6
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26 ACTUAL	0.0	0.0	0.0	84.0	56.0	28.0	186.0	0.0	0.0	0.0
EST.	.1	.0	.3	.5	3.6	4.4	14.7	17.9	44.6	38.2
DIFF.	.1	.0	.3	83.5	54.4	23.6	171.3	17.9	44.6	38.2
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27 ACTUAL	0.0	0.0	0.0	0.0	40.0	0.0	0.0	0.0	63.0	51.0
EST.	.1	.0	.0	.2	2.1	2.5	8.4	10.3	23.2	3.2
DIFF.	.1	.0	.0	.2	37.9	2.5	8.4	10.3	13.8	47.8
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 ACTUAL	0.0	0.0	52.0	0.0	133.0	0.0	674.0	112.0	56.0	79.0
EST.	.0	.0	.3	1.7	15.3	17.6	59.7	73.7	208.5	32.9
DIFF.	.0	.0	51.7	1.7	117.7	17.6	614.3	38.3	152.5	46.1
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	.91	0.00	0.00	0.00
29 ACTUAL	0.0	0.0	0.0	0.0	59.0	62.0	188.0	209.0	299.0	0.0
EST.	.6	.0	1.7	8.4	60.4	100.3	345.4	435.5	1267.3	166.6
DIFF.	.6	.0	1.7	8.4	1.4	38.3	157.4	226.5	963.3	166.6
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30 ACTUAL	0.0	13.0	72.0	183.0	517.0	437.0	1059.0	1848.0	1362.0	495.0
EST.	7.2	.2	13.2	58.7	424.2	722.1	2521.5	3140.4	7943.4	641.7
DIFF.	7.2	12.8	59.8	124.3	92.8	215.1	962.5	1292.4	6581.4	146.7
DIF/ACT.	0.00	0.00	0.00	0.00	.18	0.00	.52	.70	4.83	0.00
TOTAL ACTUAL	84457.0	8038.0	15934.0	78324.0	141608.0	131748.0	292551.0	135082.0	102421.0	48927.0
TOTAL ESTIM.	137063.8	5956.2	13869.5	77772.0	148713.6	193639.8	289122.5	206213.2	131043.4	35636.0
DIFFERENCE	56042.9	4734.7	12020.7	64153.0	57027.4	44355.2	68435.9	39326.7	40020.9	26537.9
DIFF./ACTUAL	.66	.58	.75	.42	.40	.23	.23	.20	.33	.54

SUPERZONE	21	22	23	24	25	26	27	28	29	30
1 ACTUAL	3754.0	303.0	1374.0	38.0	140.0	47.0	248.0	356.0	2508.0	17724.0
EST.	1753.3	132.3	303.9	24.7	52.6	4.0	8.9	69.0	407.6	7162.8
DIFF.	2000.7	171.7	1070.1	13.3	87.4	43.0	233.1	287.0	2100.4	10561.2
DIF/ACT.	.70	0.00	.78	0.10	0.00	0.00	0.00	0.00	.84	.60
2 ACTUAL	533.0	137.0	775.0	114.0	0.0	164.0	266.0	117.0	483.0	8587.0
EST.	1169.9	88.5	232.7	20.3	91.0	4.9	23.0	165.7	1007.6	13586.5
DIFF.	606.9	48.5	542.3	93.7	91.0	159.1	243.0	48.7	524.6	4999.5
DIF/ACT.	1.10	0.00	.70	0.10	0.00	0.00	0.00	0.00	0.00	.58

3	ACTUAL	1832.0	74.0	564.0	0.0	143.0	23.0	68.0	687.0	544.0	4032.0
	EST.	1427.1	112.6	288.8	24.8	58.5	4.5	5.7	40.2	232.8	3176.0
	DIFF.	404.9	38.6	275.2	24.8	84.5	18.5	62.3	646.8	311.2	856.0
	DIF/ACT.	.22	0.00	.49	0.00	0.00	0.00	0.00	.94	.57	.21
4	ACTUAL	146.0	0.0	320.0	0.0	0.0	0.0	48.0	140.0	170.0	2555.0
	EST.	759.8	58.7	166.2	14.9	65.5	3.7	14.7	100.9	590.6	6926.3
	DIFF.	622.8	58.7	153.8	14.9	65.5	3.7	33.3	39.1	420.6	4371.3
	DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.71
5	ACTUAL	876.0	35.0	142.0	64.0	25.0	0.0	399.0	74.0	380.0	1596.0
	EST.	515.1	39.6	110.0	9.8	36.7	2.1	5.9	40.4	234.0	1244.7
	DIFF.	360.9	4.6	32.0	54.2	11.7	2.1	393.1	33.6	146.0	351.3
	DIF/ACT.	.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.22
6	ACTUAL	249.0	40.0	39.0	0.0	0.0	0.0	62.0	0.0	0.0	728.0
	EST.	254.1	18.9	51.5	4.3	10.2	.6	.9	6.4	36.4	491.9
	DIFF.	5.1	21.1	12.5	4.3	10.2	.6	61.1	6.4	36.4	236.1
	DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.32
7	ACTUAL	341.0	0.0	83.0	0.0	0.0	23.0	96.0	0.0	0.0	476.0
	EST.	62.4	5.6	14.2	1.2	2.5	.1	.2	1.5	8.2	128.7
	DIFF.	278.6	5.6	68.8	1.2	2.5	22.9	95.8	1.5	8.2	347.3
	DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	ACTUAL	148.0	0.0	85.0	34.0	0.0	38.0	104.0	0.0	0.0	78.0
	EST.	47.2	4.3	6.2	.5	1.0	.1	.1	.6	3.3	56.5
	DIFF.	100.8	4.3	78.8	33.5	1.0	37.9	103.9	.6	3.3	21.5
	DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	ACTUAL	533.0	40.0	0.0	0.0	0.0	0.0	224.0	0.0	0.0	116.0
	EST.	209.9	23.8	17.0	1.4	2.9	.2	.1	.4	2.2	36.1
	DIFF.	323.1	16.2	17.0	1.4	2.9	.2	223.9	.4	2.2	79.9
	DIF/ACT.	.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	ACTUAL	137.0	0.0	124.0	93.0	0.0	0.0	0.0	0.0	153.0	30.0
	EST.	16.7	1.6	2.7	.2	.4	.0	.0	.0	.3	4.9
	DIFF.	120.3	1.6	121.3	92.8	.4	.0	.0	.0	152.7	25.1
	DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	ACTUAL	0.0	0.0	0.0	76.0	0.0	0.0	0.0	0.0	0.0	0.0
	EST.	32.1	3.2	4.5	.4	.9	.1	.1	.0	.6	7.2
	DIFF.	32.1	3.2	4.5	75.6	.9	.1	.1	.0	.6	7.2
	DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	ACTUAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0
	EST.	.6	.1	.1	.0	.0	.0	.0	.0	.0	.2
	DIFF.	.6	.1	.1	.0	.0	.0	.0	.0	.0	12.8
	DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	ACTUAL	2234.0	30.0	0.0	0.0	0.0	0.0	0.0	52.0	0.0	72.0
	EST.	1904.7	143.1	24.2	6.4	4.8	.3	.0	.3	1.7	13.2
	DIFF.	389.3	113.1	24.2	6.4	4.8	.3	.0	51.7	1.7	58.8
	DIF/ACT.	.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	ACTUAL	838.0	61.0	0.0	0.0	0.0	86.0	0.0	0.0	0.0	183.0
	EST.	397.5	29.7	53.4	4.2	9.5	.5	.2	1.7	8.4	58.7

	DIFF.	500.5	11.3	53.4	4.2	9.5	33.5	.2	1.7	8.4	124.3
	DIF/ACT.	.36	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.63	0.00
15	ACTUAL	2316.0	80.0	0.0	0.0	21.0	58.0	40.0	133.0	53.0	517.0
	EST.	6344.0	312.8	301.3	28.4	67.3	3.6	2.1	15.3	60.4	424.2
	DIFF.	4028.0	232.8	361.3	28.4	46.3	54.4	37.9	117.7	1.4	92.8
	DIF/ACT.	1.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.18
16	ACTUAL	3296.0	168.0	804.0	55.0	26.0	28.0	0.0	0.0	62.0	437.0
	EST.	3836.9	213.0	394.3	33.0	76.0	4.4	2.5	17.6	100.3	722.1
	DIFF.	540.9	45.0	403.7	22.0	52.0	23.6	2.5	17.6	38.3	285.1
	DIF/ACT.	.16	0.00	.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	ACTUAL	12103.0	1170.0	727.0	133.0	419.0	186.0	0.0	674.0	188.0	1659.0
	EST.	11491.5	637.4	1351.3	111.6	264.1	14.7	8.4	59.7	345.4	2521.5
	DIFF.	617.5	536.6	624.3	27.4	154.9	171.3	8.4	614.3	157.4	862.5
	DIF/ACT.	.15	.46	.86	0.00	0.00	0.00	0.00	.91	0.00	.52
18	ACTUAL	3930.0	273.0	1060.0	0.0	446.0	0.0	0.0	112.0	209.0	1848.0
	EST.	13013.5	539.3	1657.0	135.1	395.9	17.9	10.3	73.7	435.5	3140.4
	DIFF.	3023.5	306.3	597.0	135.1	52.1	17.9	10.3	38.3	226.5	1292.4
	DIF/ACT.	.30	0.00	.56	0.00	0.00	0.00	0.00	0.00	0.00	.70
19	ACTUAL	5798.0	1357.0	1744.0	0.0	327.0	0.0	43.0	56.0	293.0	1362.0
	EST.	5854.0	521.4	4110.0	330.0	818.2	44.6	29.2	208.5	1267.3	7943.4
	DIFF.	56.0	835.6	2366.0	330.0	491.2	44.6	13.8	152.5	908.3	6581.4
	DIF/ACT.	.01	.62	1.36	0.00	0.00	0.00	0.00	0.00	0.00	4.83
20	ACTUAL	19281.0	1481.0	3763.0	223.0	0.0	0.0	51.0	79.0	0.0	495.0
	EST.	6620.2	542.8	8163.0	580.4	777.6	38.2	3.2	32.9	166.6	641.7
	DIFF.	11550.8	938.2	4400.0	357.4	777.6	38.2	47.8	46.1	166.6	146.7
	DIF/ACT.	.64	.63	1.17	0.16	0.00	0.00	0.00	0.00	0.00	0.00
21	ACTUAL	0.0	13582.0	2264.0	194.0	308.0	0.0	0.0	28.0	18.0	366.0
	EST.	0.0	16637.8	3631.2	348.0	616.3	31.9	2.8	11.1	73.1	510.0
	DIFF.	0.0	2395.8	1367.2	754.0	316.3	31.9	2.8	16.9	55.1	144.0
	DIF/ACT.	0.00	.22	.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	ACTUAL	13082.0	0.0	430.0	35.0	153.0	0.0	0.0	0.0	80.0	171.0
	EST.	16037.8	0.0	441.7	116.2	77.1	3.0	.3	1.8	9.1	52.6
	DIFF.	2955.8	0.0	11.7	81.2	75.9	3.0	.3	1.8	70.9	118.4
	DIF/ACT.	.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	ACTUAL	2294.0	430.0	0.0	4522.0	9376.0	310.0	0.0	229.0	871.0	858.0
	EST.	3531.2	441.7	0.0	4036.3	5446.5	220.9	16.8	77.6	512.3	434.6
	DIFF.	1337.2	11.7	0.0	485.7	3929.5	89.1	16.8	151.4	358.7	423.4
	DIF/ACT.	.60	0.00	0.00	.11	.42	0.00	0.00	0.00	.41	.49
24	ACTUAL	134.0	35.0	4522.0	0.0	2516.0	23.0	160.0	0.0	39.0	242.0
	EST.	868.0	116.2	4036.3	0.0	1437.0	64.3	5.1	22.9	45.6	36.2
	DIFF.	734.0	81.2	485.7	0.0	1079.0	41.3	154.9	22.9	6.6	205.8
	DIF/ACT.	0.30	0.00	.11	0.30	.43	0.00	0.00	0.00	0.00	0.00
25	ACTUAL	308.0	153.0	9376.0	2516.0	0.0	2708.0	0.0	188.0	1491.0	91.0
	EST.	618.3	77.1	5446.5	1437.0	0.0	1870.2	111.9	697.6	290.0	262.4
	DIFF.	310.3	75.9	3929.5	1079.0	0.0	837.8	111.9	509.6	1201.0	171.4
	DIF/ACT.	0.00	0.00	.42	.43	0.00	.31	0.00	0.00	.81	0.00

72

Appendix A,
Attachment 5

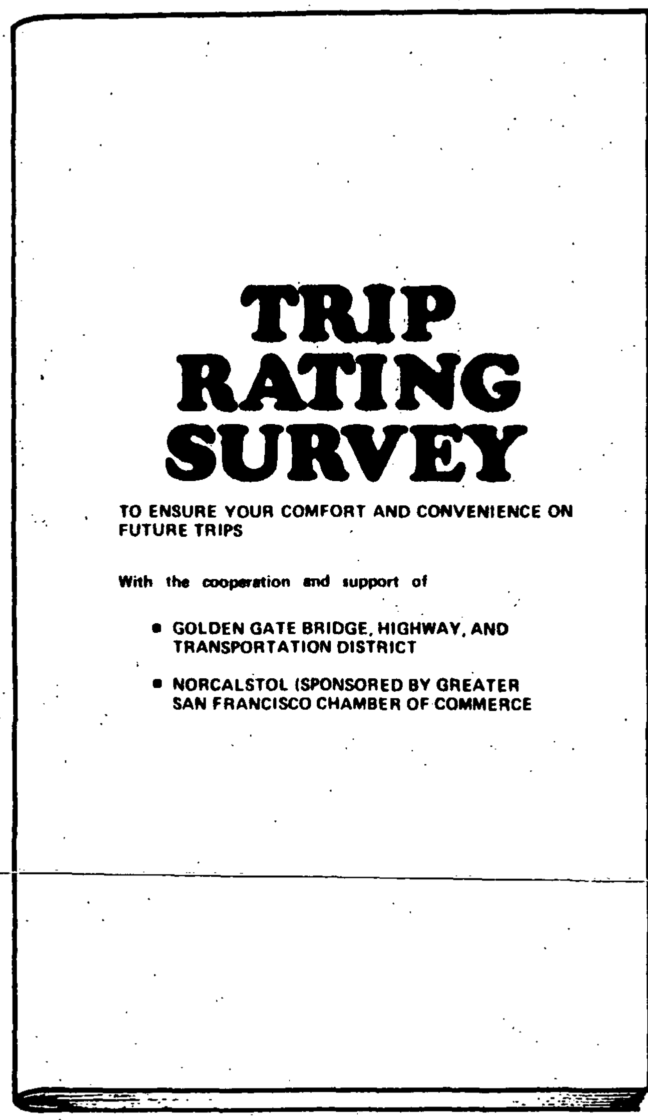
26 ACTUAL	0.0	0.0	310.0	23.0	2744.0	0.0	74.0	376.0	0.0	200.0
EST.	31.9	3.0	220.9	64.3	1876.2	0.0	302.6	912.2	145.8	7.1
DIFF.	31.9	3.0	89.1	41.3	837.8	0.0	232.6	536.2	145.8	192.9
DIF/ACT.	0.00	0.00	0.00	0.06	.31	0.00	0.00	0.00	0.00	0.00
27 ACTUAL	0.0	0.0	0.0	160.0	0.0	70.0	0.0	14320.0	7144.0	44.0
EST.	2.8	.3	16.8	5.1	111.9	302.6	0.0	14027.5	1492.7	86.7
DIFF.	2.8	.3	15.9	154.9	111.9	232.6	0.0	292.5	5651.3	42.7
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.02	.79	0.00
28 ACTUAL	28.0	0.0	229.0	0.0	188.0	376.0	14320.0	0.0	11917.0	949.0
EST.	11.1	1.8	77.5	22.9	697.6	912.2	14027.5	0.0	18396.8	736.5
DIFF.	16.9	1.8	151.4	22.9	549.6	535.2	292.5	0.0	6479.8	212.5
DIF/ACT.	0.00	0.00	0.00	0.00	0.00	0.00	.02	0.00	.54	.22
29 ACTUAL	18.0	80.0	871.0	39.0	1491.0	0.0	7144.0	11917.0	0.0	11720.0
EST.	73.1	9.1	512.3	45.6	290.0	145.8	1492.7	18396.8	0.0	5595.3
DIFF.	55.1	70.9	359.7	6.6	1201.0	145.8	5651.3	6479.8	0.0	6124.7
DIF/ACT.	0.10	0.00	.41	0.10	.81	0.00	.79	.54	0.00	.52
30 ACTUAL	355.0	171.0	853.0	242.0	31.0	200.0	44.0	949.0	11720.0	0.0
EST.	510.0	52.6	434.5	36.2	202.4	7.1	86.7	736.5	5595.3	0.0
DIFF.	144.0	118.4	423.4	205.8	171.4	192.9	42.7	212.5	6124.7	0.0
DIF/ACT.	0.00	0.00	.49	0.00	0.00	0.00	0.00	.22	.52	0.00
TOTAL ACTUAL	82471.0	19786.0	30454.0	8557.0	18381.0	4388.0	23387.0	30487.0	38335.0	57149.0
TOTAL ESTIM.	78233.8	20868.2	42130.2	8043.4	13548.6	3702.3	16162.0	35719.1	31476.0	56009.0
DIFFERENCE	33311.5	6772.8	18045.2	4152.2	10173.0	2882.2	8082.6	10327.4	25374.9	38949.4
DIFF./ACTUAL	.40	.34	.59	.48	.55	.66	.35	.34	.66	.68

TOTAL ACTUAL DEMAND, ALL SUPERZONES 3509820

SUM OF ABSOLUTE DIFFERENCES 1323346

APPENDIX B

FACSIMILE OF TRIP RATING SURVEY FORM



TRIP RATING SURVEY

TO ENSURE YOUR COMFORT AND CONVENIENCE ON FUTURE TRIPS

With the cooperation and support of

- GOLDEN GATE BRIDGE, HIGHWAY, AND TRANSPORTATION DISTRICT
- NORCALSTOL (SPONSORED BY GREATER SAN FRANCISCO CHAMBER OF COMMERCE

This facsimile of the San Francisco Bay Area trip rating survey form has been filled out to represent a fictitious, although reasonable, three mode trip, in order to illustrate the appearance of a typical completed form.

HOW DO YOU FEEL ABOUT:

1 EN ROUTE TIME

1	2	3	4	5	6	7	8	9
Exasperating				Tolerable				Barely Noticeable

2 Estimate your enroute time, excluding waiting time, in minutes:

3 WAITING TIME

1	2	3	4	5	6	7	8	9
Exasperating				Tolerable				Little or none

4 Estimate your waiting time in minutes:

5 SCHEDULE RELIABILITY

1	2	3	4	5	6	7	8	9
Often late or often not available when needed								Never late, operates at all times needed

2

	(1) Car	(2) Rail	(3) Bus	(4)	(5) OVERALL TRIP
1	9	3	1		3
2	5	60	15		
3	9	7	3		6
4	0	10	10		
5	9	8	2		4

3

6 Estimate number of times per week that some aspect of the schedule is not adequate due to lateness or inadequate service times: 5

7 SEAT AVAILABILITY

1	2	3	4	5	6	7	8	9

Never available — Guaranteed

8 ADEQUACY OF TRANSFERS

1	2	3	4	5	6	7	8	9

Detest the transfers that are required — Adequate flexibility to go where I want

9 TRANSIT TERMINAL ACCESS SPACE

1	2	3	4	5	6	7	8	9

No place to park or difficult dropoff point — Parking space always available or convenient dropoff point

10 How many times a week do you use a terminal parking space? 0

11 TRIP COST

1	2	3	4	5	6	7	8	9

Extremely expensive — Fairly expensive — Moderate — Very reasonable — Free

4

	① Car	② Rail	③ Bus	④	⑤ OVERALL TRIP
7	9	7	2		6
8	9	9	9		9
9	8				8
11	7	3	3		5

5

	① Car	② Rail	③ Bus	④	⑤ OVERALL TRIP
12 Estimate the cost to you of each part of your trip ($):	?	2^00	1^00		
13 Check the form of payment used:					
Any cash			X		
Exact change					
Free					
Tokens					
Monthly coupons					
Credit card	X				
Other		X			
14 CONVENIENCE OF METHOD OF PAYMENT	9	5	3		5
15 PARKING COSTS (If you use auto for any segment)	4				4

14 CONVENIENCE OF METHOD OF PAYMENT

1	2	3	4	5	6	7	8	9
Very poor		Poor		Adequate		Very good		Excellent

15 PARKING COSTS (If you use auto for any segment)

1	2	3	4	5	6	7	8	9
Very expensive		Fairly expensive		Moderate		Very reasonable		Free

16 What is the parking cost per trip: $ 1^00

6 7

	① Car	② Rail	③ Bus	④	⑤ OVERALL TRIP
17 SEAT COMFORT 1 2 3 4 5 6 7 8 9 1 Very poor · 3 Poor · 5 Adequate · 7 Very good · 9 Excellent	9	4	1		5
18 VEHICLE SPACIOUSNESS AND FREEDOM OF MOVEMENT 1 2 3 4 5 6 7 8 9 1 Very poor · 3 Poor · 5 Adequate · 7 Very good · 9 Excellent	9	5	7		5
19 PARCEL STORAGE SPACE IN VEHICLE 1 2 3 4 5 6 7 8 9 1 None, must be retained on person · 5 Adequate · 9 Spacious and easy access	9	7	1		8
20 VEHICLE CLIMATIC CONDITION 1 2 3 4 5 6 7 8 9 1 Always too hot or too cold · 5 Usually tolerable · 9 Always comfortable	9	5	4		6
21 SMOOTHNESS OF RIDE 1 2 3 4 5 6 7 8 9 1 Very bumpy or too much vibration · 3 Poor · 5 Adequate · 7 Very good · 9 Extremely smooth	9	3	1		4

8

22 PHYSICAL SIDE EFFECTS

1	2	3	4	5	6	7	8	9

Trip always causes motion sickness or other discomfort — Trip never causes physical discomfort

23 NOISE LEVEL IN VEHICLE

1	2	3	4	5	6	7	8	9

Conversation extremely difficult, much background and engine noise — Reasonable conversation, some background and engine noise — Comfortably quiet, barely audible engine and background noise

24 TRANSIT TERMINAL CLIMATIC CONDITION

1	2	3	4	5	6	7	8	9

Always too hot or too cold — Usually tolerable — Always comfortable

25 TRANSIT TERMINAL WAITING ROOM FACILITIES

1	2	3	4	5	6	7	8	9

Dirty, uncomfortable, inadequate — Adequate — Excellent, very clean, modern

	(1) Car	(2) Rail	(3) Bus	(4)	(5) OVERALL TRIP
22	9	8	5		7
23	8	1	1		2
24	9	5	5		6
25	9	4	3		4

10 11

	① Car	② Rail	③ Bus	④	⑤ OVERALL TRIP
26 SERVICE ASSISTANCE		3	2		2
27 ROUTE ALTERNATIVES (OVERALL TRIP)					5
28 PERSONAL SAFETY AND SECURITY	7	8	1		4
29 VEHICLE APPEAL	9	9	1		4

26 SERVICE ASSISTANCE

1	2	3	4	5	6	7	8	9

No service help from conductors, clerks, etc — Excellent service help with ticketing, boarding, luggage, etc

27 ROUTE ALTERNATIVES (OVERALL TRIP)

1	2	3	4	5	6	7	8	9

No freedom in choice of personally desirable ways and times to travel — Ability to reach destination at will almost effortlessly

28 PERSONAL SAFETY AND SECURITY

1	2	3	4	5	6	7	8	9

Very apprehensive whenever using this mode — Some feelings of anxiety, but feel secure in general — Always feel very safe and secure, nothing to worry about

29 VEHICLE APPEAL

1	2	3	4	5	6	7	8	9

Dirty, decrepit, disgusting — Acceptable decor and cleanliness — Modern, always very clean and attractive

12 13

① Car	② Rail	③ Bus	④	⑤ OVERALL TRIP

30 PRIVACY

1	2	3	4	5	6	7	8	9
No opportunity ever to be alone				Reasonable distance from others can usually be maintained				Can always be either alone or with others as I please

Car	Rail	Bus	4	Overall trip
9	1	1		5

31 PRODUCTIVE USE OF TIME

1	2	3	4	5	6	7	8	9
Not able to think or work due to inconveniences of mode								Can use time of travel very productively for personal or business purposes

Car	Rail	Bus	4	Overall trip
1	4	1		2

32 OVERALL OPINION OF MODE COMBINATION USED

1	2	3	4	5	6	7	8	9
Poor		Fair		Good		Very good		Excellent

Overall trip: 3

14

15

① Car	② Rail	③ Bus	④	⑤ OVERALL TRIP

33 How many times a week do you usually make a trip like the one you have just rated?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☑ 5 ☐ 6 or more

34 Is there any other reasonable way you could make this trip?

☑ YES ☐ NO

If yes, by how many minutes would you be willing to adjust your schedule in order to continue to use this mode combination rather than the other way?

1☐ 0 min 2☐ Up to 5 min 3☐ Up to 10 min 4☑ Up to 15 min 5☐ Up to 30 min 6☐ Up to 60 min 7☐ Up to 2 hrs 8☐ Up to 5 hrs 9☐ More than 5 hrs

35 If you answered yes in the question above, how much more would you be willing to pay to continue to use this mode combination rather than the other way?

1☑ 0 2☐ Up to 25c more 3☐ Up to 50c more 4☐ Up to 75c more 5☐ Up to $1.00 more 6☐ Up to $1.50 more 7☐ Up to $2.00 more 8☐ Up to $5.00 more 9☐ More than $5.00

36 Are you traveling alone?

☐ YES ☑ NO

If no, how many are there in your group?

1☐ 1 2☑ 2 3☐ 3 4☐ 4-6 5☐ 7 or more

37 What time did you start out on your trip? A.M. 6:45 P.M. ____

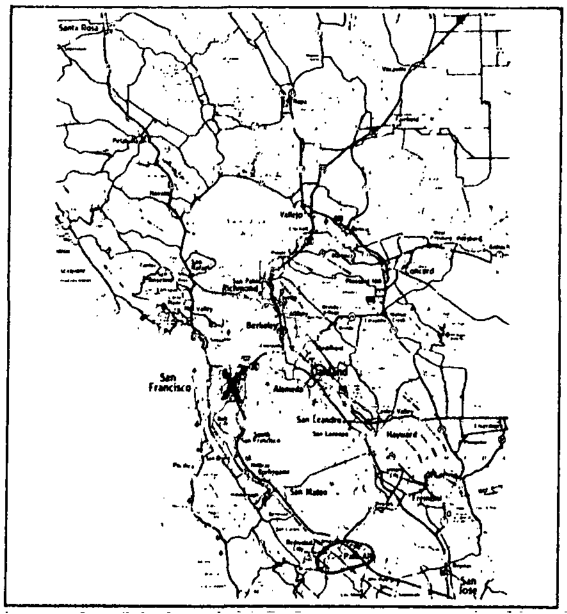
38 What was the purpose for your trip?

1☐ Going home
2☑ Going to work
3☐ Work related business
4☐ Personal business
5☐ On way to recreation
6☐ Visit friends-relatives
7☐ Medical dental
8☐ School
9☐ Shopping
10☐ Eat meal
11☐ Other

16

39 How long do you expect to be away from home (or office if business side trip)?

1☐ Less than 1 hour
2☐ 1-2 hours
3☐ 3-5 hours
4☐ 6-10 hours
5☑ 11 hours to one day
6☐ More than one day



40 Please indicate (approximately) the following locations:
1. The place where your trip began by an "O."
2. Your destination by an "X."

If your trip origin or destination are beyond this map area, please tell us the place of Origin ____ Destination ____

17

① Car	② Rail	③ Bus	④	⑤ OVERALL TRIP

FOR STATISTICAL PURPOSES ONLY

PLEASE ANSWER THE FOLLOWING QUESTIONS CONCERNING YOU AND YOUR FAMILY, SO THAT WE WILL BE ABLE TO DETERMINE WHETHER MEN HAVE DIFFERENT PREFERENCES THAN WOMEN, WHETHER MARRIED PEOPLE HAVE DIFFERENT PREFERENCES THAN SINGLE PEOPLE, AND SO ON.

41 You are
- 1 ☑ Male
- 2 ☐ Female

42 Your age is
- 1 ☐ Under 18
- 2 ☐ 18-21
- 3 ☑ 22 25
- 4 ☐ 26 35
- 5 ☐ 36-45
- 6 ☐ 46-55
- 7 ☐ 56-65
- 8 ☐ Over 65

43 You are
- 1 ☐ Single
- 2 ☑ Married, no children
- 3 ☐ Single, one or more children
- 4 ☐ Married, one or more children
- 5 ☐ Widowed

44 What is your occupation? Accountant

18

45 How far did you go in school?
- 1 ☐ Did not complete high school
- 2 ☐ Completed high school
- 3 ☐ Some college
- 4 ☑ Completed college
- 5 ☐ One or more higher degrees

46 What is your approximate yearly family income before taxes? (Your income plus that of your husband or wife or the person on whom you are dependent)
- 1 ☐ Under $5,000
- 2 ☐ $5,000 to $7,499
- 3 ☐ $7,500 to $9,999
- 4 ☐ $10,000 to $12,499
- 5 ☑ $12,500 to $14,999
- 6 ☐ $15,000 to $19,999
- 7 ☐ $20,000 to $24,999
- 8 ☐ $25,000 to $39,999
- 9 ☐ $40,000 or over

47 How many automobiles (including trucks, campers, etc.) are owned or available for use by members of your household?
- 1 ☐ None
- 2 ☐ One
- 3 ☑ Two
- 4 ☐ Three or more

48 If there are other factors that you feel are important to your selection of travel modes that have not been covered, please comment and list below

THANK YOU FOR YOUR COOPERATION

19

APPENDIX C

OPEN END COMMENTS

The open-end comments are listed on the following pages, categorized either by principal mode of travel referred to, or as general or unclassified. The letters in the right hand column indicate references to other modes or categories as follows:

Bus, including street car	B
Automobile	A
Rail	R
Ferry	F
Helicopter	H
BART	BT
Cable car	CC
Cycle	C
Taxi, including charter bus and jitney	T
Air	P
Walk	W
General	G
Unclassified	U

BUS

I have possibly become spoiled by the Greyhound bus lines - where space and general comfort exists. Upon moving to Hayward and adopting the AC transit for the past nine months, I have found an incredible lack of leg room (being 6 ft.) and generally uncomfortable conditions - which includes standing on occasions. Hot in winter and summer, etc. Because of these reasons (believe it or not) I am selling my home in Hayward and moving back to Concord where AC does not have a monopoly on commuter service. If budget (gas, insurance, bridge, city parking) would permit, I would drive my own car. How expensive will BART be? BT A

Re: Question #28 - I just suffered a great deal of inconvenience and pain when my already injured foot was caught in the bus door.

I would be delighted to be able to take a bus directly from Sonoma to ferry building or transit terminal to arrive in S.F. by 7:45 a.m. - particularly if it were a nice bus like the double-decker that goes to Ignacio Valley from S.F. There must be a lot of us who are willing to put up with a long commute for the quiet of Sonoma who would change to decent bus travel. Presently one must go to Petaluma or pick up a bus on the Novato run after a 30(+) minute drive in a personal car. I lived in an apartment in S.F. where I used S.F. bus #55. Service, in general, good. Crowded both ways. Some extremely poor drivers (jerky starts and stops and "hot rod" drivers) and 3 or 4 excellent drivers. Noisy buses. Overloaded; had to walk once in awhile when bus couldn't make it up Sacramento. Fare of 25 cents is fair. Also used cable car at times - which was good for the spirit, except when tourist time rolled around - cars greatly overloaded. CC

On Berkeley-Shattuck run no covered bus stops or bicycle racks. C

I used to travel on the new S.F. Muni diesel bus which was very clean and well maintained - the noise, however, was dreadful. The electric bus I use now is very dirty, windows always jammed so ventilation poor. On the whole, I feel S.F. Muni is very good in its service.

Answers are for trip to office (home bound is quite different). On #8, my reason for driving to bus is inadequate transfer. The survey is grossly inadequate due to not being able to rate both directions. There are no places where any question even hints at recommending solutions to existing problems. A

No alternative to bus except private automobile. A

I ride the Municipal bus and the new buses are atrocious. The time schedule is adequate but very seldom adhered to. Muni needs an overhaul badly.

The smell of the buses now makes me extremely nauseated - I have become super sensitive - almost allergic reaction which was not present before I started commuting.

Greyhound bus transportation from C. Costa County is very good and quite responsive to commuter needs.

I use Greyhound bus. I leave Concord 6 a.m. - and go real fast (45 min.). If I wait until 6:45 or 7:00, traffic slows bus so I may be late. This is my biggest complaint, but this is not the fault of bus company.

Would prefer to travel by car but costs are prohibitive, particularly downtown parking. When BART is available, the comfort will improve, but cost will nearly double. I could tolerate the bus for the savings involved. BT A

I will switch from AC bus to BART when possible. BT

If proper effort is made, I believe bus travel has the greatest potential for commute problems at least cost.

Will not use combustion-powered buses in the city; electrically-powered vehicles which are far superior from all aspects do not serve my route. If I may: I fail to recognize what advantage was gained by the city of San Francisco in purchasing more of the recent combustion-powered buses. This type of decision is what exasperates the public mass. What possible advantage was gained? I have yet to see one, even one. Was it the "lowest bid?" I would like to see, in print, the upkeep and maintenance costs of these buses, as compared to the electric lines. If the main purpose was to transport humanity on a large scale with a minimum of comfort and no consideration of the occupants, they succeeded.

Other people on buses are the single most distressing factor. Fewer people the better.

Commuter bus transportation is rapidly becoming intolerable in Marin County. If service and comfort is not improved in six months, I will either drive a personal car to the ferry or move from Marin County to a suburban area more convenient to San Francisco. A

Foregoing based on commute times - off-hour service. S. Mateo/S.F. would add at least one half hour to travel time, plus earlier departures based on less frequent scheduling. Could alternately use train, but during non-commute times their schedules are even worse. R

I take a streetcar to work but sometimes have to take S.F. Muni buses, in my off-work hours. The new buses are far too noisy, uncomfortable, poorly designed - i.e., windows. There is evidence of poor quality control, they ride very poorly - they are offensive for air pollution and noise pollution for people on the street.

Many streetcars are in very bad shape. On hot days when streetcars are crowded, I have found no window that can be opened. In over-all analysis, the Muni is not worth 25 cents. There has to be vast improvements to make the Muni suitable to my demands for comfortable transportation.

When adequate time is available, prefer to walk but tight schedule requires bus ride 95% of the time. Ride Sacramento (#55) from Leavenworth and Clay to end of line. Buses are very overcrowded and frequently 5 buses will go by before one stops (about 1/3 of those that don't stop have standing room to take on most people waiting at stop, only about once every two weeks is there room to sit anyway). Buses generally come in groups of 2 and 3. 95% of the time the last bus in one of these groups is the one that stops. W

I consider my commute from Piedmont to So. Beale to be "ideal". I would not change a thing - and I would resist having to drive my own car daily. A

Can take the diesel bus which is noisier, goes less directly and takes 4 minutes longer and requires one and one half blocks more walking. Live far enough out so that when once a month I see standees in bus, I wait 1 or 2 minutes and get the next one. When I go home late or come in on Saturday may have up to 20 minutes wait and as it is 45 minutes to walk could have gotten there quicker if I'd have known I just missed one.

My trip in the evening on the 38 Geary bus is bad on account of drivers. Just opposite the morning trip on the #55, which is almost excellent.

Primarily depend on Greyhound from Marin Co. Could use ferry but would have to transfer to a bus at Sausalito. Would be more convenient if ferry terminal could be located some place in central Marin. F

I do not use public transportation because the buses are full of grouchy people who don't smile, and that starts the day off poorly, and makes it end the same way. So please don't feel it's the fault of the buses or their drivers. I just prefer pleasant surroundings, and work at having them.

The factor most disagreeable is that bus drivers pick up more passengers than safe operation of the vehicles allow.

Smoking on bus - discomfort. Engine exhaust condition in bus and terminal - discomfort.

Bus time given is typical for summer trip, in winter the bus trip normally takes from 10-15 minutes longer.

I use the slower local bus because of the over-crowded conditions of the express. The express would only save me 10 minutes each way.

I ride the Muni. Find I can get anywhere by transferring which is fine, but feel buses are too crowded and one is jostled too much.

The Livermore/Pleasanton/Dublin to San Francisco commute should justify public transportation on the basis of population and projected use. No published schedule seems to be available as to when such service can be expected.

Stopped taking the "B" local which stops almost in front of my door. This is like a milk train, stopping at every corner and the aisle jammed with standees. More buses are needed for this route in the morning commute hours. Express buses at Lake Park and Lakeshore are excellent. Bay Bridge over-congested with autos. Buses are fastest and most comfortable means of transportation.

Marin County Greyhound will terminate service December 1, 1971, and service will be by G.G. Transit Authority. Hopefully will be an improvement.

Seat availability should be subject to average number of people per stop, not start filling as many as possible at earlier stops and not being able to take any at later stops.

I would be extremely unhappy if my trans-bay bus transportation were discontinued and I was forced to use BART and local bus service - my cost would almost double and my trip time would probably increase by about 50% due to the location of my home in the Oakland Hills. A bus trip between my home and a BART station would take nearly the same time as my present total commute. In fact, I would probably turn to a car pool as a more economical, less time consuming alternative. A BT

The information furnished for this survey might well be titled "A Rush Hour Trip on the Muni #38 (Geary St.) Bus." It's like starting every day with a challenging adventure. Each driver is an individual and has moods but in the two years of riding the #38, I have yet to meet a rude driver or one who refused to give detailed information. Every morning they attack Geary St. (or O'Farrel) in assault groups of three or four. The vanguard always takes the brunt of the attack and consequently the lead bus becomes wall to wall people. The last bus of the group may even have empty seats. Since the timing of the assaults is reasonably predictable, it's often possible to select the trailing bus and have enough room to stand without being bumped. I favor this system because it gives preference to veteran riders. It also gives the drivers interest in their work and sharpens their reactions.

I appreciate these additional advantages offered by AC transit: (1) high frequency of service on main lines; (2) adequate micro-distribution system; (3) possibility to interrupt a trip and within one hour continue at no extra cost; and (4) good and friendly drivers.

BUS (continued)

Greyhound transportation is so good now between S.F. and Walnut Creek that I am having second thoughts about BART. Although I believe BART is the correct long-range answer. BT

The Muni is poor - I walk to and from work to maintain sanity. Dist = 18 blocks, Time = 35 minutes. W

Terrible bus connecting service from home to downtown Hayward A Street and Mission.

Number of transfers per trip (2) number of bus stops after boarding and (3) driving habits of bus drivers.

An average speed of only slightly over 15 mph is ridiculous. Greyhound service along Skyline Blvd. to the Ferry Bldg. with decent buses would go a long way toward improving my commute. The present Greyhound service along Skyline is virtually useless; the scheduling is ridiculous; inbound only 3 buses all leaving within a 15-minute period around 7:00; outbound only 3 buses all leaving within a 15-minute period around 5:00 - both are too early. Also, the buses do not stop at Hickey Blvd. And the equipment has to be among the oldest buses still running outside S.F.'s Muni.

Bus or train - over-all less exasperating than rush hour traffic A
by car - also feel odds for long longevity better. R

Commute by Greyhound bus from Ignatia station Novato, to ferry bldg. In general, Greyhound is good transportation - all they need is road space to drive in during rush hours.

Alternative transportation is Greyhound with ratings as follows: (did ride for two years until became unbearable)

1 - 1	10 - 0	18 - 1	26 - 3
2 - 60+10	11 - 3	19 - 1	27 - 1
3 - 1	12 - 0.80 + auto from	20 - 2	28 - 4
4 - 10	house to	21 - 1	29 - 2
5 - 1	bus stop	22 - 3	30 - 1
6 - 5	13 - monthly coupons	23 - 1	31 - 3
7 - 7	14 - 5	24 - none	32 - 2
8 - 8	15 - 9	25 - none	
9 - 1	16 - 0		
	17 - 1		

Greyhound buses usually very well timed but during July/August evening (5-6 p.m.) service hopeless, due to buses being used for tourist trips during afternoon and returning late to depot. Wait at ferry bldg. hopeless - no seats - no shelter - no phones. F

This survey is confusing; trips vary during a week. Many Muni men go through red lights - very bad - making a ride to or from work a harrowing experience. For a short trip, walking might be the best solution. W

BUS (continued)

Anybody would be crazy to drive over the Bay Bridge when he didn't have to (in commute hours). The bus driver who takes off his coat, rolls up his sleeves, and then turns the heat on full should be fired!

Transportation by bus from S. F. to Castro Valley after 6 p.m. and on weekends is very long and tedious.

Bus trip will be replaced by BART trip. BT

Use of city bus between S.P. depot and downtown is intolerable.

San Francisco badly needs 24 hour a day bus and trolley service. Transportation outside of weekday day shift hours is inadequate.

It would be a tremendous improvement if part of my commute time could be recoverable through reading or study - the Greyhound is too bumpy! It is also dirty! We have to wait in weather for Greyhound in S.F. They could use the Fremont Terminal.

It is not only uncomfortable but unsafe for passengers to stand on buses - especially on freeways, and unfair to them when paying same as those who obtain seats. I would pay more for a seat. Windows should open at top so those standing could have some oxygen. Those seated will not open windows because of draft. It is inconceivable to me that those planning buses have not thought of this.

Bus is only available mode of public transportation. Would need 3-4 people to make car pool economically feasible. Ferry system from Corte Madera may not cut travel time or cost, but would be used by me if available. A F

As alternative I like to use the cable car over the San Francisco hills without getting motion sick and take the bus only in the flat part of the city. The new engine driven buses are more comfortable, but much too noisy and stinky! CC

I have bus just to 6 p.m., going home. If I have to stay in the city longer than that, I have to drive. A

The reason I would be unwilling to pay higher prices for better service is that 25 cents is a high price for the poor service received from buses. If the buses were more attractive and reliable, perhaps the influx of automobiles into the city could be eradicated.

Bus is over-crowded and too stuffy - poor ventilation.

Wonderful getting to work. Often one hour or more on return trip home - same route. Buses don't stop to pick up passengers.

BUS (continued)

I use Muni bus and Greyhound buses.

The Alameda Contra Costa bus system is very capable for my purposes and it would be impossible to improve on its service for me.

Public transportation does not reach our area. We would like to take the bus from where we live to go to work.

I have travelled by bus, Greyhound in particular, to some places - the drivers are very courteous and excellent in handling the bus they drive. However, I feel that NO SMOKING should be strictly enforced - it's at times sickening to inhale all that smoke and when you get out of the bus, it seems like you smell like you have smoked a cigarette yourself.

I used to take the Muni until I got fed up with trolley breakdowns (Market Street), drivers that make you feel like you are in a rodeo, standing up on way to/from work, poor service after 6:00 p.m., and a host of smaller inconveniences. Breakdowns and rodeos are my biggest complaint.

Answers to this survey concern only transportation to work. Travel at other times by bus is usually less desirable.

In general, I am very happy taking the bus to work - almost nothing could make me drive; but the time on the bus approaching the bridge could definitely be improved. Maybe a bus lane all the way across?

Please find some way of forcing one-driver cars to stop commuting during rush hour over Bay Bridge. Each morning I ride a bus across the Bay Bridge. At least 90% of the vehicles on the bridge are one-driver cars. I suggest a very high tax or toll on one-driver cars. Requires 15 minute wait at toll gate. A

AC transit buses are lousy - one stops in front of my house but I won't use it due to terminal waiting time and poor human comfort!

The inconsistency of scheduled arrivals is a problem. Some drivers are extremely ill-mannered. The condition of street cars is poor. The construction for BART causes delays - especially in evenings. Power failure is also a problem needing attention.

Must transfer or provide for ride if not travelling during commute hours. Have seen roaches, ants, etc., on buses with other litter. Drivers are extremely courteous.

I take the Muni bus. It is dirty! The windows are greasy, seats filthy and ripped.

BUS (continued)

Bus drivers are rude at times. When irritated, they drive deliberately fast and jerky. Windows should be open when route begins as it is warm and some passengers are indignant when you open the window. Old green buses should not be used as they cannot climb the hill and passengers must get off (Sacramento 55).

I take the #30 express Muni. The schedule in the a.m. is fairly reasonable, but the 5:00 afternoon schedule is totally impossible. I see no reason for my being jammed into a bus, after waiting a minimum of 25 minutes with hundreds of tired, irate commuters. Are the majority of #30 expresses hidden after the morning rush? If not, where are they after work?

On my trip to work, I make a detour to my daughter's nursery school, then go the opposite direction, so I have to pay another fare (the same going home). I will soon have a car so this will change. A

The main objection to the evening bus ride home over steep hills, old buses, overloaded, erratic in appearance at 4:30; extremely slow, jerky progress on hills tending to produce motion sickness when passengers are paying "express" rates. Upon protest by petition "Muni" passengers were told the old buses have to be used up "somewhere" - but why in a dangerous situation that several times have caused passengers to leave the bus, walk up Pine Street hills and get back on the bus at the top -- at "express" fares. The bus is so overloaded it can't move.

The Muni system is better to get to work in morning than to get home in the evening.

Bus transportation is reliable, but buses are crowded, bumpy, noisy, and are often known to break down. I am very much in favor of mass transportation, as opposed to automobile travel. A

No. 15 Northbound should not go to Pacific only. All 15's should go/terminate at Wharf. Below average drivers.

The old, pokey, green buses should not be used on the #55 Sacramento bus run. They barely make the hills, and too often don't, causing passengers to unload and wait again. Many people won't ride these green buses, and will wait till a more reliable new bus comes. I rated this transportation survey with the newer bus in mind; if, however, I had rated the old, slow bus, my rating would have been much lower.

The bus is usually so crowded, I walk! Waiting time and crowds are my only complaint. Sometimes it is quicker to walk (it is close to work though). The #55 Sacramento is too crowded; so is the cable car! When not crowded - it is fine! W CC

I think they should have 1 or 2 more buses going to city from Marin Co. around 7:30 a.m. to 7:45 a.m.

BUS (continued)

The worst problem is the transfer buses. The Muni 15 and 42 never run enough buses and it is usually a question of chance, whether or not one can reach one's train in time. Also, when the buses do arrive, they are already packed like sardines. Also, at the railway station, if an empty bus is across the street which people have not yet crossed, the driver will not wait for the passengers to arrive, but generally will take off the moment the light turns green. This naturally causes an overload for the buses that follow. The problem of inadequate bus transportation exists both coming from and going to work. I have noticed an over-abundance of empty Muni cars passing the Bush Street stop, for instance, and often wonder why many of these cars (2's, 15's, etc.) are not transferred over to 42's and 15's where they are needed.

City bus drivers would just run into you if you let them!

This morning there was no necessity to leave the backed-up street cars on Market Street and get off and walk but many mornings it is necessary - like last Friday. With the 2 other walking periods plus standing to and from work, this extra walk is quite exasperating, physically and time wise. Also, I note often that one car is immediately followed by another almost empty. If you miss these you are due for a long wait. It would appear that one car does not want to travel alone which may be the case.

Muni is crowded - not all of the buses go as far as others of the same number. If they all ran far enough they wouldn't be as crowded as the buses that go furthest are now.

I use the Muni buses (electric). The drivers are objectionable and so are the people who live in the area my bus passes through.

When I don't travel with my husband, I use the Marin Greyhound service. My major complaint about it is the crowded condition of buses - I normally stand for the entire 35 minute trip. I prefer the ferry, but it does not run on a schedule convenient for me. F

S.F. Muni bus service to Pacific Heights could be improved by (1) more buses between 6 p.m. and 7 p.m. (2) do not stop every block (3) drivers should not be so reckless.

I live in the upper Haight. Bus transportation was adequate until a few months ago when all the Express buses were removed from my stop (Haight/Masonic). Now my travel time to and from work has nearly doubled and I am continually frustrated by seeing half empty buses going by.

I use the Municipal Railway system and feel that most of its unpleasant features are due to the excessively crowded buses.

Taking the Greyhound commute bus "S" is fine during rush hour, but it is extremely inconvenient to take the regular "C" or "D" bus at other times during the day, especially at night. The buses don't come very frequently, and the "C" and "D" buses make many more stops so it takes much longer to get home. Also, the Greyhound depot on 7th and Market is just ghastly. I'm afraid to go there at night, so if I catch a late bus, I have to wait on Sutter and Van Ness, where there is no bus shelter or anything. I would like to see the main Greyhound depot completely renovated, or better yet, relocated to a less sleezy part of town. Evening service from S.F. to Marin and vice versa might be supplemented by adding more buses, if it would be economically feasible. Driving continues to be the easiest form of transportation, but parking in the city is either so inconvenient or expensive that it is impractical for day to day commuting. A

Generally unsanitary and impeded conditions along 3rd Street, S.F. make bus and/or walking conditions inferior. Sidewalk loungers and panhandlers increase unpleasant aspect of this segment of journey. Bus ride is simply enclosed version of above. W

Based this on Muni service. Sometimes use Jitney down Mission Street which has better service but crowded by the time it gets to my corner. T

I will soon be moving to San Ramon, and would very much like to have Greyhound extend its service from Danville to the Crow Canyon Juct. There are probably quite a few S.F. commuters in this area.

We would use public transportation if available and reasonably priced. However, it doesn't look like any such thing is in sight for us in Sonoma. The Marin Greyhound buses are the most disgusting and nauseating thing on the road. They make, not only the passengers, but the other commuters sick - the fumes are so bad.

A bus is the only other transportation, it's more uncomfortable due to the smells and takes longer. Also a longer walk to work would be involved. BART could be too expensive. BT

More buses should be put on heavy populated routes.

Would drive to work but parking too expensive. Bus drivers should operate bus in a smoother driving fashion. Too jerky? A

Very adequately covered. Obviously the 10 minute bus trip is enough to ruin a day. The train just numbs you, but nothing better. R

Please ask John Woods and the staff of the San Francisco Muni to ride their system to and from work each day for 90 days. Things would improve!

BUS (continued)

Buses are too crowded. People are packed on like sardines. Drivers drive too fast and bus motion is jerky.

On the way home, do not feel it is safe to walk instead of bus unless attended by gentleman companion. W

The "J" church line is fairly regular in the morning; however, it becomes full early in the trip, leaving many passengers without a ride. The afternoon schedule is unreliable. I would appreciate having a printed schedule for all Muni lines, to better organize my intra-city travel. The schedule would only be helpful if the buses run on time.

I am a San Franciscan commuter - my overall feeling about the Muni in the city is poor. The bus drivers (majority) have a poor attitude. I take the 41 bus and frankly, the condition of this line is frightening. The drivers seem to have many problems with the gears and the brakes seem to need replacements. I sincerely hope this survey will help in our city commute.

I find city transportation generally good in San Francisco except in the general area where I live - as there are NO express or Limited buses - so a 10 minute drive to work takes me 40 minutes on a bus plus 10 minutes walking time. I find this intolerable. A

Would prefer to use transfers to continue on same line after short stop and for stops other than transfer points. As long as the time limit hasn't expired what's the difference? I usually use a private car for shopping because I refuse to pay Muni several fares. Climatic condition stuffy. Windows in new buses don't open as well as old buses. Smoothness of ride depends on driver. Many are jerky, making abrupt stops after racing down the hills. New buses are louder than older buses. Extremes in weather make rides uncomfortable. Many seats are ripped by vandals with trash on floors by return trip very frequently. My bus is the 55 Sacramento line which is, in my riding experiences in the Marina/Pacific Heights area, one of the best in the city. A

Have been injured few times as there is no place to hold on when quick stops are made. Sometimes when I stand - no place to hold on to.

AC transit is doing a good job with S.F. commute. Admit my opinion may be influenced by having ridden S.F. Muni in recent years. Would rather walk and even then you are not safe. W

It would be extremely helpful if service was more frequent; this would cut out my proportionate waiting time to travel (50%).

Bus transportation in S.F. excellent in the morning; after 5 p.m., sometimes three times a week up to 20-25 minute waiting period for already crowded, hot bus.

I am criticizing only the S.F. Muni Railway - particularly #6, #10, and #2. My difficulties are mostly due to #6 which has different destinations to and from town; therefore, I am often not sure if I will be forced to get off at a point near the end of the line and wait for another bus. Market Street is undoubtedly the cause for most tie ups, but buses seem to come all at once particularly at night and then they are rerouted because they are late and do not go to the end of the line. The drivers go through yellow lights and particularly on the #2 Express drive as if they were on a roller coaster. Since drivers no longer make change, it would seem that they could answer passenger questions with some courtesy.

I am extremely uncomfortable in the street cars. They are so terribly bumpy that I wonder sometimes if I will fall out of my seat.

Muni RR basically okey; new buses are simply <u>miserable</u>. I am a tall man.

Worst link of the trip is Muni-bus. Just read with despair that SP is planning to move the station <u>further</u> away from the city - should extend rail link to center of city instead of the "end of the world" as it is now. R

In the morning, I usually take the S.F. Muni bus from train depot to Sutter & Kearney. This service is increasingly unpredictable as to quality of vehicle, arrival at depot time, departure time and operator-endeavor to leave intermediate stops promptly - though still generally tolerable at the price. In view of the bus service, if the price increased significantly, I would be inclined to walk from the depot to work. Presently, the bus is generally quicker in the morning, but slower at night. I would not take it at night unless (a) raining very hard, (b) physically unable to walk, (c) off-peak hours, improving speed to depot or making walking unpalatable. SP very good, overall. Driving has seemed to be quicker on the average than the train, overall, but more expensive W
and much less satisfactory from the standpoint of use of time and R
psychological wear and tear. A

I must leave office at 4:45 to catch bus as crowds will be too big at bus stop for me to catch 5:14 express train. However, that puts me at station 10 minutes early, so I wait. Cost of R
parking makes driving impossible. A

Building elevator service terrible. Adds about 5 more minutes on both ends - usually! At least 3 in the morning and sometimes almost 8 at night because of full ones.

Express service and frequent departures only available during peak periods. At other times (e.g., early afternoon) waiting time would rate "exasperating."

On this trip I rode in a modern AC transit bus (#155) to work. Occasionally it happens when the bus company decides to give the run an older bus. On this ride the statistics differ quite dramatically. My own personal mode of travel is as follows:

6:25 a.m. - leave home for bus stop
6:35 a.m. - bus leaves for San Francisco
6:51 a.m. - bus arrives at San Francisco/East Bay bus terminal
6:51 a.m. - 6:57 a.m. - walk from terminal to 50 Beale Street Building

The Greyhound buses serving Corte Madera are: crowded, dirty, noisy, no ventilation, slow, unreliable, expensive, cause huge air pollution. Hope to get ferry serving Corte Madera - S.F.; present ferries from Tiburon or Sausalito do not help reducing the worse traffic jam at Mill Valley caused by bad highway construction and lack of regulating traffic. F

Why must you confuse the issue? The questions are not related strictly to my trip in this morning (which was excellent). On Monday, a.m., the waiting is fantastic with the result that I rarely take the bus on Mondays. Thursday and Friday are best.

Bus is convenient for return home from work, but very inconvenient on trip to work due to distance (because of one-way street set-up) and inconsistency of schedule and waiting times; therefore, it is simpler to walk to work than to ride and takes less time. However, walking is unpleasant during inclement weather, and I wish it were easier to find a bus at those times. W

The AC transit commute is quite good - only problem is Bay Bridge congestion. BART is going to have to go some to attract me away from it, and yet I want very much to see BART succeed. BT

Smog bothers me both in transit terminal and on freeway. AC transit terminal is extremely noisy. Greyhound buses exceed comfortable noise levels.

I board the bus on the last stop (inbound) of express line Y (Greyhound). Possibility of getting on the bus is very unpredictable. Frequently many buses will not stop to pick up passengers because all seats are occupied. Going to other stops or lines is quite inconvenient. Drivers are not willing to take passengers for short (10 min.) ride to possible transfer points or offer to take standing passengers.

Comfortable, clean cars. Express service, during rush hours. Elimination of non-scheduled transfers (near 30th Avenue). Less stops, faster vehicles. Availability of cash change in the cars. Enforcement of "No Smoking" rule inside the cars.

Frequently able to secure auto ride to office, but dependent upon bus for return home. A

BUS (continued)

The public transportation system of S.F. is over crowded. The buses are noisy, emit carbon monoxide and other gases that make being around them unpleasant - these fumes are also inside the buses. After the second stop, there is no seating room. Buses are rarely on schedule.

Convenient bus service is not available within walking distance of my home.

My bus runs commuter hours only, but is very inconvenient if I need to go home at any other time or come to work after a Dr. appt. for example.

I enjoy reading very much so I find it easy to pass the time. I should not want to transfer, or drive 20 minutes for a ferry. I enjoy getting off at Broadway and Embarcadero just to walk 10-12 minutes to Market and Beale.

I am able to walk to my stop from home and walk from the terminal to work. If I was forced to drive to a terminal and pay a substantial parking fee I probably would drive directly to San Francisco. The general performance of the AC transit employees is outstanding. Their training program should be recommended to the S.F. Muni and BART. A

One of the deciding (and major) factors in moving from San Francisco to Walnut Creek was the intollerably frustrating Muni 17 express daily trip - plus any other exposure to Muni - including waits of almost an hour frequently for a bus with a seat. And NOISE!! And this commute takes me door to door no longer than the Muni.

Smoking! I quit the AC bus because they would not be firm about NO SMOKING. They claimed they couldn't do much, but Greyhound doesn't tolerate it. Even with well air-conditioned buses, this is important. Also, it is not adequate to just confine smoking to the rear. There should be NO SMOKING in confined quarters.

The commute to work is quite different from the commute back. After a day at work, I am tired and not looking forward to being bounced and jostled home. On the commute in, however, I sleep and the movement of the bus does not bother me. Because I walk from the bus station to home, I do not choose to sleep on the returning trip. W

Elimination of bus fumes in bus terminal at San Francisco.

No commute bus service to Fremont.

The fact that there is a special bus lane on the Bay Bridge is essential.

I ride with an associate when he is driving and take bus when he isn't, which is about half the time. A

Re: Bus Type Travel: 1. Provide adequate seating space. The space allotted on the Marin Greyhound commuter buses is inadequate for 2 adult males. 2. Suit jackets and sports coats tend to wrinkle terribly. Provide hooks on seatbacks or overhead racks to help keep business clothes neat.

The bus system is poor, over-priced, uncomfortable, and unattractive. Greyhound might try replacing the antiques they call commuter buses.

Buses operate on schedule insofar as traffic permits. Better buses could not maintain better schedules unless city and highway routes are improved. The present buses are extremely uncomfortable as to seating and temperature, but the ferry building terminal is very convenient for me, and I would personally forego comfort to avoid tne time that would be required to get to a distant point in order to catch a bus, if this were required in order to have better buses. At the Ferry Building terminal buses leave as loaded, and there is always a seat. Again, I would rather sit on an uncomfortable bus than stand on a comfortable one. The brief wait at the Ferry Building terminal is at least under a cover of sorts and boarding is reasonably orderly and in turn. Again I would personally forego other advantages in order to avoid helter-skelter waiting on a street corner. In short, as one personal expression of preference, I would be happy with more comfortable transportation and willing to pay a reasonable increase in cost for it; but I am very much more concerned with time.

I commute 42 miles (one way) to work. The transit district advertises that they use new air conditioned cross-country buses for these long hauls. This is a fallacy since two-thirds of buses on the schedule that I use are old "klunks" or "asphyxiation traps." We usually wait for a good bus and have to arrange our schedule accordingly. Cross-country buses being used extensively on the short hauls to Berkeley and downtown Oakland, which adds insult to injury. Being over six feet tall and weighing over 200 pounds I have difficulty finding a comfortable seat on a public conveyance. Also, there are ordinances against smoking, but passengers ignore them, nor are they enforced by the transit district or local public officials. These two problem areas are supposed to be corrected with the advent of BART? I anxiously await this mode of transportation. BT

The <u>only</u> reason I do not go by (a) Greyhound is that they are stinky and inconvenient and (b) ferry schedules are inadequate for my working time. As soon as extra ferry service is available - we will go Golden Gateway. F

I ride the N-Judah Street car and I hope the route time improves when the BART tunneling is complete. BT

I am more fortunate than most Greyhound commuters since the particular bus I take is an air conditioned highway bus that makes one round trip from Inverness, through Fairfax, to the Ferry Building each day. If it wasn't for the air conditioning and the more comfortable seats - the bus trip is miserable, all my ratings would be very low.

The cost is less than driving a car, and the travel time is less.

	car	bus
Time	35 min.	30 min.
	$3	$.50
Mental Anguish	very much	very little

A

Waiting for a bus on a chilly or rainy morning can be made very unpleasant. Although bus is at the station, it will not be pulled ahead or door opened for boarding the unheated vehicle. Also, I would like to mention, there is no shelter. People in lines.

Used S.F. Muni trans., but ride was physically uncomfortable.

At the present time my commute cost 60 cents one way and the trip takes only 35-40 minutes, practically door to door. When BART starts, this AC transit service will be shut off. The travel time will be increased and the fare doubled. BT

The new buses Marin County will receive will increase this rating.

I use AC transit instead of a car pool. The bus offers more flexibility. A

More express buses starting at 4:00 p.m.

I work nights (11:45 p.m. to 7:45 a.m.). Bus schedule is very poor at that time of night.

Prefer additional bus transportation to eliminate automobile commute. A

I drive 2 miles to get the bus. There are no parking facilities at the terminal so I rent a space for $6/month nearby. I go to work an hour early to avoid the rush traffic - have always had a seat on any bus. The main problem is lack of space for both me (6'2") and anything I may carry. The return trip may take 1 1/2 - 1 3/4 hours depending on traffic - accidents, etc.

I would use public transportation from my house if there was a shelter on the street to wait for a bus in winter.

I think the transportation by Muni Railroad in San Francisco has deteriorated past comment.

I would gladly use a bus system that used road lanes reserved exclusively for buses.

I changed my time of departure approximately 5 months ago due to inadequate service. I now leave 1/2 hour earlier to be sure of a seat. I arrive at the office about an hour early. This is better than standing.

It is nice to have good scenery along the way. Noisy buses should not be allowed in public areas, which automatically rules out all aircraft. P

I live just a little too far from work to walk in a reasonable time each morning. Yet the Muni fare is still the full 25 cents. Rates or fares ought to be graduated-similar to Greyhound, BART, etc.

Greyhound commute buses should be replaced by newer vehicles or at least serviced more frequently. Private commute cars with one passenger should be charged double or even triple at Bridge Gates - then maybe there would be less traffic. During commute times, the bus takes approximately 1 to 1 1/2 hours from Concord to S.F. This is ridiculous. A

Replies refer to East Bay Alameda-Contra Costa Transit service, generally good. S.F. Muni service is far inferior. Replies refer to westbound a.m. trip. Eastbound p.m. trans-Bay homeward trip is all by bus, less comfortable, slower, more inconvenient. The great trouble with public transit is waiting time at transfer points. Replies weighted by proportion of old, rough, noisy buses in AC transit service.

The exact same trip is done in the evening. The main reason for walking both ways (from bus to work and work to bus) is because it costs 25 cents to go 7 blocks. I save fifty cents a day, whereas if I took the bus it would cost me $6.25 a week as opposed to the $3.75 it costs me now. Yearly average taking just buses is $300 (for crummy transportation). I can only walk though in the evenings till daylight savings time as I feel the streets in S.F. are fairly unsafe after dark, they are even unsafe in the day time but the risks seem slighter. Also, the bus rates always seem to be going up, but the conditions seems to be getting worse. I feel that increases are good in their own way, but there should be some benefits to the people who have to pay them. W

I think you could have asked whether the other passengers are courteous; polite; etc. I have found that the people on the train fit that category but the other passengers on the bus absolutely do not. R

Incoming buses more reliable than outgoing.

Special bus lanes would make great difference.

Takes one hour to make the return trip at commute time. Around-about route.

BUS (continued)

More even air and temperature control on buses. Protection from the rain at the Concord bus terminal. Increase availability of parking space in the area of the Concord terminal. During busy (rush) hours for the "Y" bus, two buses should be loading at all times. Greyhound has poor communications during loading procedures.

Provide shelter or protection from weather during winter season while waiting for bus.

Trip is inconvenient during winter due to rain, wind, etc. For a time, I drove from home to Hayward Plunge to catch bus to S.F., but that parking lot is now closed. For some unknown reason. Worst situation of trip is lack of free parking in area of bus stops forcing me to walk from home to bus stop and then return by same mode in evening. A

Buses are scheduled at too early times and then are almost unavailable for the rest of the day. I am also forced to leave at least an hour early in order to get a bus with an empty seat.

Dangerous concentration of exhaust fumes in S.F. bus terminal may require change of travel mode.

Questionnaire does not ask about what system used, i.e., Greyhound, AC Transit, SP, etc. My answers pertain to AC transit. Difficult to arrive at accurate conclusion with grading system. Commute buses and a regular run during days totally different. Plenty of seats, privacy sometimes on regular runs. On commuters, bus usually full, some SRO, after final pickup. Answers to 0-7-17-18-20-21-24-29-30 have variables to apply clear out of number system. Too much depends on hour, number of people, traffic, weather, etc. I prefer AC because it is cheaper than driving, I avoid frustrations of driving in congested, stop and go traffic, wear and tear on nerves and car, finding parking. I can relax, plan day on bus. A

For this particular trip (commute) the bus is the only logical mode to and from these ideally located points. For most other trips, the lack of flexibility inherent in public transportation makes the automobile (private or taxi) logical. A

Generally, city buses are poorly ventilated because windows cannot be opened at the top. Most window openings cause drafts directly on passengers who are seated.

Buses to work are comfortable; those going home are uncomfortable and slow.

The bus I use operates between 6:45 a.m. and 7:20 a.m. and between 4:45 p.m. and 5:20 p.m. This can be very inconvenient at times.

BUS (continued)

Public transportation tried and rejected: (1) Bus carrier to 7th St. depot plus city bus or street car to Market and Main. Daily cost of $1.56 daily plus waiting between carriers plus lengthy exposure to rain, wind, etc., plus standing enroute and inconvenience. (2) Due to off-duty auto injury which restricted driving, I used street car line for six months with eye to using same indefinitely, but found it intolerable. War-time railway conditions were not half as bad! Used family drop-off and would always have had to use same or two separate carriers without transfer privileges. No public parking near car lines (some day a must!). Trip unreasonably long, cars criminally over-crowded, minimum 3-4 block walk at each end - no possibility of reading or working - always standing room only with possibility of being knocked down - carriers in deplorable condition. Conclusion: Resoundingly unsatisfactory. Lest that sounds spoiled, may I point out I used nothing but public transportation for 35 years nation-wide plus in the Orient. A.

Bus service from Alameda to S.F. is good. It would be very undesirable to have to go to Oakland and transfer to BART. BT

It is pretty bad to take 50 minutes to travel only 4 miles - standing in a crowded streetcar.

The last few blocks of downtown bus traffic are excessively hampered by auto traffic and construction work.

A. The most disagreeable part of my daily commute trip (100 miles) is the loss of time (3 to 4 hours/day). B. The over-all costs/month are higher than indicated if you consider the necessity of buying meals in the city because of excessive travel time. C. I would change mode of travel to improve (A) and or (B) if anything were available.

This refers to the trip leaving San Francisco. Coming in in the morning there is little waiting time and the bus runs on schedule.

The foul air from cigarette smoking on the bus is one of the most objectionable features of my bus commute.

AUTOMOBILE

I must travel 5 miles by car between Moraga and Orinda on Moraga Way. This one-way road is completely inadequate for the commute traffic. After 8:00 a.m., very few Greyhound buses that stop in Orinda have seats available. Drivers generally are unpleasant concerning accepting cash for ticket. B

Parking in S.F. too expensive. Parking space near bus terminal in San Rafael not adequate. No provision made for waiting for bus. In winter must stand in line in the rain. (San Rafael terminal) B

I ride in a car pool where one fellow does all the driving and the rest of us pay him. We are a very congenial group, so much so that I almost look forward to the daily commute.

Our car pool consists of men, not willing to drive their only car to work and leaving their wives without transportation. Not willing to be driven by their wives to the highway to wait for the darn bus in all sorts of weather. Very willing to contribute less than bus fare to the car pool and be picked up at home. You plan a better way - let us know. B

Before travelling by car, I used to take the Muni bus. Time is extremely important to me. I must be at the day nursery school in So. San Francisco by 6:00 to pick up my little boy. At times I found this impossible and had to pay a fine for being late. I also found this very frustrating - to get off work at 4:45 and be unable to reach So. San Francisco by 6:00. By resorting to driving, I now am able to pick my boy up and be home by 5:30. B

I find driving a car convenient because I depend solely on myself and do not have to wait for a bus, be pushed and shoved by people, or have to stand. B

I like the mobility of using a car to commute because I do not have to start my day on a definite-to-the-minute schedule. When I'm ready to go, I go - no rushing to catch a bus or waiting for the next one. Buses make me sleep and I am groggy when I get to work or home; whereas in car, even while driving, I have plenty of time to think and plan, listen to news, etc., because I have to stay awake. As far as ferry boats go, I prefer them to buses, but the one which is privately owned has a schedule which is inconvenient. I avoid using "public" transportation with the same vigor I avoid buying stolen goods. B F

A car could be used to commute; however, it would cost more, take longer, and be less convenient since parking is a problem.

It is unfair to be included in the AC Transit District and pay taxes to support it only to have to drive 13 miles to Castro Valley for the nearest bus service. (Ditto for BART when available.) Freeway faciliites are inadequate for the volume of traffic at peak hours on 580 between Pleasanton and Castro Valley. If our tax money could be spent to expand AC Transit service, I could understand somewhat why Pleasanton and Livermore are not in San Joaquin County instead of Alameda County. BT B

I travel by car as it is more convenient for me. I think it would be better if public transportation were easier to cope with. Nasty people and mean bus drivers make anyone's day start off lousy. B

Six members in the car pool. One member does not drive, but pays for monthly parking in city. Each of the remaining 5 members drives the others in his own car one day per week. From door to door (no walking) the pool has operated thus for six years.

My husband and I are working in the city. It is more convenient (for less or the same cost as the bus) to have a car in the city, in case one of us has to work overtime. Post rush hour service of Greyhound is terrible (length of time spent and waiting time). B

. Driving is the only alternative available at this time.
- Am looking forward to using Larkspur ferry when becomes operational. F

If costs continue to rise, I will be forced to join a group and use automobile transportation.

Within walking distance of home. Inexpensive when compared to automobile. No more (or little more) expensive than a private car pool.

There is no reasonable place to park my car; therefore, I have to resort to rather expensive public transportation.

It costs $1.50 to drive and park my car daily; $1 to ride the bus. The transit time is the same. So I would pay just about 50 cents more before I would use my car only. A car allows me greater freedom of departure time. B

There is <u>no</u> public transportation available to me in the municipality in which I live. I <u>must</u> drive to a busline. B

I believe cheaper parking should be available (convenient that is!). More people should be induced to form car pools.

My husband drops me off (and picks me up) on his way to and from school; he pays 50 cents parking at his school.

I use my car in my work and have to have it available to me otherwise I would consider bus or BART. Company pays my bridge toll and parking expense. B BT

Use car pool 3 times/week. Must use personal auto other 2 days/week because public transportation is not available for return home at 10 p.m. Also, city (Muni) transportation very difficult for after 10 p.m. travel. B

My husband and I leave in our car together; he drops me at work and then parks the car about a 10-minute walk from his office. About once a week, I take the bus home to Orinda. There is no public transportation (except cab for $5) from the crossroads so I always have to make sure I have a ride home. When BART comes in, and if it proves less expensive than our present arrangement, we will use it. B T BT

Occasionally I will drive which reduces the amount of travel time; however, the cost is greatly increased mainly because of unreasonable parking rates. If you park in a reasonable lot, then there is an unreasonable travel time between the lot and work.

Toll very expensive in car. Everyday plus parking and gas runs up to quite a bit of money. We have no buses and AC transit has not yet been completed - even so it would still run into a good deal of money. B

Recent back surgery makes waiting for or standing in public transportation impossible.

I hate driving to work - but the transportation from Diamond Heights is so bad - it takes one to one and one-half hours to get to Montogomery St., a distance of 5 miles. B

I am disabled from waist down and automobile only mode of transportation I can use. I hope when rapid transit arrives, and in order to pay for it, we all will be taxed, that people who are disabled will be able to use their cars in the various cities serviced. It is better to keep a disabled person employed than to have him receive welfare.

Freeway traffic during commute hours prohibits driving unless absolutely necessary.

Car not used due to traffic, wear and tear on nerves, longer time involved, parking costs, gas costs, car wear and tear, and general inconvenience and worry of car commute.

My husband travels to one area of the city for classes, while I work in another area. Travelling by car (with no parking fee) costs less, at present, than two separate public transportation tickets and inter-city bus fares. Ferry docks and schedules are not convenient for us, at present. B F

Rode the train until the last strike - have found that it is just about the same cost for both of us (husband works 4 blocks from wife) to use family truck as train and bus charges. If necessary would use train and bus again - but like it better this way. R B

The reason we use the car is because there is no bus service for Daly City to speak of and the reason I park free at the Presidio and suffer on a Muni is because parking downtown is outrageously high. By taking a car directly downtown from Daly City I could cut 1/2 hour off my travel time. B

Car not in good enough condition to make whole trip each way every day. Also, freeways and bridge much too dangerous.

Never use bus, rail, etc.; only use household car.

Since I am confined to a wheelchair, the only mode of transportation available is auto. This should enter into consideration when reviewing the answers that I've given.

Would use bicycle if special, safe bike paths were available; but freeways and major arteries too crowded during rush hours for safety. C

Not only is my private car the only available transportation to work, but it is sometimes used as local transportation while at work. Also my private car is the only dependable transportation in the case of an emergency at home or elsewhere.

Within the area mapped in (40) one simply does not consider any modes of transport other than personal auto. The alternatives (taxi and bus) are simply too inconvenient and time consuming, T
regardless of cost, particularly when transporting a family. B

There is no alternative to driving to work in my case. Some form of public transportation would be very acceptable to me, especially if it would reduce the number and congestion of vehicles on the road and help reduce air pollution.

No bus service available. We use a car pool sometimes, but not every day.

Highway #17 heavy traffic, Highway #84 heavy traffic and excessive toll; Highway #101 heavy traffic; Highway #237 heavy traffic; Highway #84 salt on pavement; too much smog.

We live in a rural setting quite removed from bus lines, etc., without leaving a car at a terminal.

Better law enforcement. I almost had a wreck this morning due to a speeding (over 70 mph) double hopper sand truck weaving and cutting in and out of heavy commute traffic.

Auto travel between home and job is the only reasonable mode available. The distance is too far to walk and bike travel on the roads approaching Moffett Field is very dangerous. (I tried riding my bike to work often times, but was almost run down each time.) C

Most of my travelling is done by car - especially local travelling so much of this isn't applicable to me.

There are absolutely no alternatives to travelling this route except by automobile - private or taxicab. T

Car (car pool or own) is <u>only</u> available mode of transportation for trip.

Principle travel is local - town-shopping. Distant travel usually by car.

I have never used public transportation in the 8 1/2 years that I have resided in the Bay area. I travel 5 miles each way between home and work with virtually no problems or inconveniences.

Have no alternative to personal car for trips outside of local community area.

There are no other modes of transportation available. If public transportation was available, I would use it.

At present there is no public transportation where I live. I have no other choice but to drive my car. I would be very happy to see BART extended to Pleasanton or reasonably close by. BT

Now use private auto for commute to work. Will probably use BART when available. BT

Dont' feel I was of much help, in that car is most practical and feasible for areas travelled.

99% of our travel is by auto partly due to poor and inconvenient available public transportation.

Both morning and afternoon I travel in the opposite direction to the main flow of traffic.

Prefer to eliminate the use of car between S.F. and East Bay.

I would like to be able to use public transportation, but at present this is not possible. Looking forward to BART's completion, the only reservation I have is the availability of transportation from terminal to work. BT

Other transportation is not available.

My daily commute to and from work is from one small community to another via freeway that is not heavily travelled. There are no stop lights. Also, there is no public transportation conveniently available.

Need vehicle in course of work - no local public transportation (except taxi) is available. T

Mode of transport will probably change when Walnut Creek to Oakland Service begins on Bay Area Rapid Transit. BT

Travel is to and from work. Auto is the only mode. I am the only one who lives in Fremont and works in the office. No other choices of transportation.

Would enjoy taking a bus if there were frequent schedules (which there are not). Enjoy reading on a bus if it is (a) roomy and (b) air conditioned. B

Presently using a car pool. BART will serve me just as well but I am afraid the price will be out of reason. If BART is reasonable at all, I will use it. BT

At present using company auto; however, if subjected to own vehicle, comments and answers would be similar. Costs for parking facilities are considered good.

Don't like to commute all the way to city by car because of tension of driving and cost of parking there.

Questionnaire is hardly applicable to one driving his own car. Additionally, being located in Belmont colors replies.

I am a widower with one 9 year old at home, which prevents me from leaving home in the a.m. prior to 6:45, which necessitates my using auto to go to work. Otherwise, I would take the S.F. commuter train. The big hang-up in going to and from work is the very bad driving habits of commuters on the freeways. These people do not show any consideration for each other. At heart most of them are very discourteous. R

Driving own car allowed freedom, if needed, to work after hours and return home safely, securely in short amount of time, as opposed to questionable safety on a later city bus! B

Almost all my travel is done by private auto. Where I live there is no other mode of transportation available. I do not believe I was the most logical choice for answering this questionnaire as I am from way out of the area in which I work.

I am not crazy enough to want to drive in S.F. Parking (cheap) is impossible.

Car pool is more satisfactory than Greyhound, largely because it is quicker by about 30 minutes. B

I usually drive a company car to work.

No public transportation available at home.

One alternative I can avail myself of is a car pool which would save me about 20 cents a day but I would rather drive my car so I can go to any place at will during lunch break or after work.

A. Car best mode for emergencies, 1) at home, 2) to reach home from work. B. Conveniency of handling personal business during lunch hours.

S.F. parking fees; Bay Bridge fare.

We in Livermore, feel that we should be provided with a means of transportation other than personal car. There is a definite need for bus service. Also since we are in Alameda County, we pay the taxes for transportation service but receive none. B

RAIL

Rail transportation is by far the best method. The S.P. would be better if they would improve their evening schedules, and if the terminal were closer to downtown than at 3rd and Townsend.

Suggest that S.P. arrange for rail terminal closer to downtown San Francisco.

When rating S.P., I used the new coaches and compared prices with East Coast. Environment of walk from S.F. station to office is not here rated, but important to me. I would not own a second car except for commute to station. A

Alternative is to drive and that is unacceptable. Bad part of trip is the 15-20 minutes from rail depot to office. Trip would be fine if depot were downtown and better if rapid transit extended down the peninsula. A

This rating covers one-way (to work) of a typical roundtrip each day. The walking (1) is voluntary and enjoyable, generally. The primary problem is the distance of the rail terminal from my place of work. W

Prefer train to hectic pace and tension of Bayshore driving. A

Your greatest service to Peninsula commuters would be development of a reasonable connection between the S.P. terminal and the financial district. B

The main factor is what could be done that is not now done. S.P. really does not care about passenger service. The country at large does not care much about it either. If we get any improvement, it will be a miracle.

S.P. needs monthly parking tickets and season transportation tickets. A transfer system available for monthly tickets to change from train to bus. (Transfer system). B

Use the old key system terminal as a downtown train depot.

We need high-speed, cleaner, more modern rail transportation.

More "express" trains needed between 5:30 p.m. and 6:00 p.m.

Southern Pacific trains make good time during commute hours but later trains are too slow and therefore we have to use auto part of time. An ideal system would make good time at any hour and pay one fare all the way through. A

If cost of this trip rose by 75 cents, I would drive all the way, as it would be cheaper to drive and overall trip would be reduced 30 minutes each way by driving. A

The train and ride is 100% better than driving, but these strikes are a bear. Also, S.P. station in San Francisco could use more open windows as a convenience to passengers on a time schedule.

Too much smoking! (train)

The new coaches are without a toilet and I think each car should be equipped with one. The new coaches have no window shades and the colored glass does not keep out the sun and heat. The morning early trains take too long to get to S.F. because of the many stops. The early trains in the evening are okey. The Greyhound takes only 48 minutes to reach S.F. B

If an S.P. train left S.F. earlier than 5:26 p.m. and stopped at San Bruno would use train in place of car (say 5:10 p.m.). A

I do not mind driving the automobile to and from station but one should be able to be transported to the central downtown working area without any more transfers and faster. A

S.P. R.R. time plus bus from 3rd and Townsend to work and back has not changed to any great degree since 1920. Check some of old R.R. schedules. If we can get to the moon we should be able to get into S.F. faster. B

Greater time flexibility would be desirable in commuting and service frequency is spotty outside of a fairly narrow band (especially in evening) i.e., the rail transportation. This forces one to drive if a close schedule cannot be maintained - such as an early evening meeting. A

Peninsula train service has 2 defects: (1) it ends at 3rd and Townsend instead of Market or Mission St. or other location within walking distance of financial district and downtown. (2) off peak service is much too in frequent.

The S.P. commute train is excellent. I consider $30/month reasonable. It's the problem of getting to and from the train especially in San Francisco that is the biggest problem.

Would appreciate more modern rail equipment and faster running time. It would be better if the S.F. rail depot were more convenient to connecting transportation or nearer the center of business district. Terminal was built for the 1915 fair I believe.

FERRY

If a ferry service from San Rafael or Corte Madera to the Ferry Bldg. (with adequate free parking on the Marin side) existed, I would prefer to use such service.

Being able to move around during the trip, go outside and enjoy the fresh air, the sun, and the view.

A more convenient ferry terminal - Larkspur - would change my mode of transit from walk-bus-walk to walk-ferry-walk. B

Shuttle buses to ferry landings (dependable).

Would enjoy ferry transportation from San Rafael. Schedule not convenient for those in Northern Marin. Car commute is outrageously expensive when you include parking. A

How about a ferry to San Rafael.

Bring on the ferries ASAP!

Would use ferry boat if closer port (proposed Corte Madera Facility), and if transit time, departures, etc., flexible enough and short enough.

Ferry - Sausalito to San Francisco. Not enough scheduled during rush hours; e.g., 4:10 and then 5:30.

I would prefer to use the ferry both ways on my commute - as it is now I ride the bus in the morning and the ferry in the afternoon. B

An 8 a.m. departure from Sausalito would better serve my schedule.

I am a visitor in San Francisco and this is the first time I have used ferry.

Ferry service should be available all over the Bay to S.F.

My only criticism of ferry service is slowness of unloading and loading passengers.

During school, could the number of field trips be limited to one per ferry trip? Please have heat on the new ones. Ferry, especially lower deck, is very noisy. Concession prices are outrageous.

Basic problem with use of ferry is lack of ferry at key commute time - 8:15 a.m.

FERRY (continued)

I particularly enjoy ferry travel by reason of interesting and beautiful maritime scenery, refreshing sea air, pleasant people aboard, absence of confining atmosphere such as in car or bus, availability of morning coffee/doughnuts, unusually accommodating personnel (they'll wait if they see you running for the boat or feeder bus instead of leaving you behind to save 15 seconds on the schedule, etc.). It would certainly help if ferry service could be extended farther North, particularly to avoid traffic mess south of Corte Madera; also would welcome terminal parking at dock or within easy walking distance. I frequently miss feeder bus because I come such a long way so there is considerable opportunity for something to go wrong and upset timing somewhere enroute between home and ferry dock. B

The travel must be relaxing and esthetic. This is achieved only on the ferry. The inability or unwillingness of bus manufacturers and operation to develop a quiet and comfortable bus is disgusting. They obviously do not care. Until they do, I refuse to ride them. B

I would take the ferry twice as much if the after work schedule were more appropriate. I would prefer another ferry between 4:45 and 5:15 p.m., leaving San Francisco. Not only that, but the 5:30 ferry is too crowded. Since I do not wish to wait half an hour for a ferry, I take a bus home. B

I am a daily commuter on the ferry and think the entire operation is excellent.

Normal transportation is via business station wagon. The bus/ferry trip is only possible when the car is not needed in S.F. A B

Esthetic appeal of passage by water.

The ferry is in great need of more service at the Larkspur terminal. I support the concept of a lounge/plastic dome on the third deck of the new boats.

Prefer monthly coupons to cash.

Large tables would be more fully used as well as provide opportunities for social intercourse.

I believe that on cold days and in the winter time a warmer combination of interior colors would attract more passengers to the ferry. Perhaps even a more 19th century decor - a pot bellied, wood burning stove or two perhaps?

Extremely convenient for going to work as bus stop at both ends is very close to home and office. B

FERRY (continued)

Why when new slip was built did you not allow for unloading from both sides simultaneously?

I consider the ferry trip from Sausalito to San Francisco one of the most pleasurable sightseeing trips of this area - for visitors <u>and</u> natives like myself!

Time it takes is lousy!

I enjoy the walk from the ferry terminal in San Francisco to my office. I look forward to the ferry ride and apprecaite the bus. But, I wish very much that the bus routes could be extended to Larkspur (where I live) so that the expense and inconvenience of driving to the parking lot could be saved. B A

Need (1) more crossings (i.e., more boats) and (2) more efficient method(s) of ticket collection to speed up boarding and unloading.

I am a high school student. I work and study in Marin. I feel great need for some discount in the price, and perhaps a ferry leaving San Francisco earlier.

The trip is too short. The boat is so pleasant, it should take longer. Very difficult to find bicycle parking in San Francisco - more safe parking should be provided. C

Greyhound bus service between S.F. and Marin is <u>very</u> uncomfortable - buses are too old, noisy, smelly and bumpy. I find buses too warm all year. No fresh air - passengers dislike open windows. Lots of fresh air and freedom on ferry. Rather drive and pay $2.50 roundtrip than ride Greyhound. Also, some Greyhound drivers discourteous or at least unfriendly which ruins a trip. Ferry service is great (a little too crowded in summer and during 5:30 p.m. service. B

I think Greyhound is not ecologically minded at all - gas and exhaust fumes fill the air - schedules seem to be good but much prefer the GG bus and ferry to work and back. More modern, more fun, more chance to meet people! B

Weather - when it isn't a pleasant day, I go Greyhound rather than go below on the ferry. B

Ferry is pleasant - feeder buses are punctual and convenient. However, would be more desirable if trips were more frequent, schedule more flexible! B

Would like to see some kind of S.F. transportation from terminal during rainy weather to Financial District.

The South Street bus in the morning to the 8:25 and 9:40 or 9:50, leaves South Street ahead of schedule. The bus for the 7:15 is excellent. B

FERRY (continued)

Weather determines mode of arrival to destination in S.F. When bad - add 50 cents/day in additional bus fares. B

I am extremely impressed by the ferry service. It's fast, comfortable, service is excellent and it uses the Bay as an esthetic and logical means of transportation. My only objection is the drive to the terminal. A

Children should be restrained from running around the deck and up and down the stairs, as though playing hide and seek, with apparently no parental supervision or restriction.

Ferry boats are good for sole souls like me; I'm no mole nor Greyhound rat. Though fat I walk to bus, bus to boat, get some coffee, then I float to work. I do not shirk.

Keep those ferries running! They make Bay area living more tolerable and interesting. A few more craft for 5-6:30 p.m. runs would be good. The gap in service for Tiburon 5:45 - gap - 7:10 is more disconcerting for people leaving work at 5:30. They can drink a lot that they would rather not in those 85 minutes or so. Too long to wait.

When the ticket booth in Sausalito isn't open and bus driver runs out of tickets, there are no indications as to where one purchases a ferry ticket. All people involved are very friendly to ask, but a sign might help. I think riding the ferry, no matter how one has to get there, is an absolutely exhilarating experience. I use it whenever possible - personal business, shopping, meeting my husband, etc. I am occasionally tempted by a hair-do-proof, one-mode-of-transit method of travel. But the current cost of parking in S.F. has made multiple-stop trips by car nearly prohibitive except for millionaires. Therefore, viva ferry boats! Please try not to raise your prices! A

Generally outstanding. Good way to start the day. However, seating is none too inviting - suggest vinyl upholstered individual chairs of good design and comfort as well as more comfortable bench seating with arms.

You have the only sane way to get to S.F.

Too many tourists during commute period.

Enjoyable scenery - which you excell in. Thanks for the enjoyable service.

The Golden Gate boat from Sausalito to San Francisco is the best thing that has happened in years. The method of operation and staff are superb.

Schedule flexibility is inadequate. Look forward to S.F. - Larkspur Ferry service on a regular basis.

FERRY (continued)

During the summer I take the ferry boat home to Tiburon for relief from the bus. B

Would greatly prefer ferry if scheduling were adequate.

I use the Golden Gate Bridge District Ferry Service occasionally and find it very enjoyable, but it takes more time (including bus trip from Mill Valley to Sausalito) than the Greyhound bus (which is poor). B

Start ferry boat service from San Quentin.

Would prefer ferry.

More ferries!!!

Enjoy thoroughly the opportunity to bicycle to work! Please no covered upper deck! Need improved safe bike route through Sausalito. Love that ferry! C

First Marin-Ferry boat bus - departs 6:03 (parking lot); majority passengers - stock brokers; security traders; arrival time work - 6:45; desired time arrival, 6:20; suggestion: earlier ferry-bus. B

Should have a ferry getting to ferry building by 8:15 a.m. and one leaving at 5 p.m.

I am very grateful for the consideration shown to bicyclists. Hopefully the new vessels will be laid out to minimize their convenience to the non-cycling passengers. C

The ferry coffee stinks! The ferry donuts and rolls stink! Not enough ferries and buses to make frequent availabilities for night work in city. Nobody really cares!!! More buses and ferries to the people. Free rides. B

Ferry is the most enjoyable mode of transportation from Mill Valley. However, because of two factors this mode is only used 3 out of 6 days by my wife and/or I: (1) daily work start hours for wife of 6:50 a.m. and (2) lack of available speedy transit to place of work from the S.F. ferry building at this hour.

More frequent ferry times and less crowding on evening ferry as e.g., 5:15 and 5:45 boats to split commute rush. Better lighting - put on a dome for experiment.

Ferries afford scenic views, sociability if desired, amenities such as coffee bar, wet bar. Slow ferries are better than fast surface vehicles.

HELICOPTER

We have to find something better than parking cars at airports - probably better transit or shuttling services. A

My case may be considered "not typical" because I am a ticket agent who must sign-in in S.F., fly to Oakland and work there from 2 p.m. - 8 p.m., fly back to S.F. and work there from 8:30-10:30. My company has a pass for helicopter portion of trip.

This is the first and possibly only time that I will use this particular travel mode combination.

Inconvenience at terminal (SFO) prompts extension of trip by helicopter to permit pickup at Oakland airport.

The transfer of baggage to SFO helicopter terminal in S.F. from incoming flights is in a terrible state of affairs. At least 75% of times with a guaranteed connection my luggage is never with me on my OH flight to Oakland. Then the company only delivers baggage between 10 and 11 p.m.

I do not use any of these modes regularly. I took the helicopter from the Oakland Airport to the S.F. airport to catch a plane to Buffalo. This was my first time using the helicopter. I found it very convenient plus reasonably priced. P

Would like to see more use of rapid transit methods in all airports. Parking is bad. A

I am not a resident or commuter but have used helicopter twice when flying to West coast to visit family - so most of these questions do not apply. We find it good and convenient except for excessive noise. Also had trouble getting porter for bags at airport.

I do use helicopter service on average of 2 times a month on business. Find it noisy, windy, cramped but better than driving and parking car in S.F. airport. Oakland airport is more convenient. A

BART

Rapid transit from Santa Rosa to S.F. connecting with BART would be enthusiastically welcomed.

For me, having to use the BART system would be a disadvantage, since the public transportation I use now is as fast as conceivable for a mass transportation system.

I urge the extension of BART to the Livermore-Pleasanton area as quickly as possible, certainly before extension to the airport.

I plan to use BART, but would like to see a feeder bus in Concord to the BART station. B

I feel BART would be a great help to people living in Marin County.

If BART is more expensive and less convenient as I expect it will be, I will continue to ride AC transit buses. If BART forces AC transit to discontinue its bus service, I will be extremely unhappy. B

I will be an enthusiastic user of BART. For commuter morale, steps are recommended in order to discourage auto use during rush hours: (1) raise auto bridge tolls during rush hours (2) apply penalty bridge tolls for partially filled cars (3) lengthen priority bus lanes approaching bridge toll plazas and (4) offer discounts on A
bus tickets to hot pants and mini skirts. B

The non-availability of BART.

Good bus connections with BART will be helpful. B

I would like rapid transit like BART for San Mateo County.

Public transportation still beats using own car to go all the way to downtown S.F. I'm looking forward to BART. A

Time and alternatives will improve with BART. Trip is excellent considering distance involved. The best improvement would be public transit from Pleasanton rather than San Leandro.

Please hurry with BART.

I wish something like BART would come west of the Bay.

Please hurry with BART. Keep BART fares down so more can/will ride and will all help make BART a success. I hope more lines will be available at a future date, i.e., airport, San Jose.

Let's get BART rolling.

BART (continued)

Traffic - but alternative, bus, is subject to same problem. BART, hopefully, will solve this.

Travel from Alameda to San Francisco via BART will not improve travel unless the destination is very far from the bus terminal.

BART service is expected to improve both time and comfort, at little additional cost, for this trip within approximately 1 1/2 years.

I will not take BART. I'll drive first. A

When BART is in operation, it may be more convenient, but if there is a fare increase I would rather take the bus. B

When BART goes into operation, I plan to use these facilities, initially. If the cost is too high or service is unsatisfactory, a group of us are planning to form a car pool. A

CABLE CAR

I still like the cable car, although it is often late or too crowded. I hate to go by bus, it is always too full and the ride is very uncomfortable. B

Although I know restrictions are impossible, I wish tourists would not use cable cars during 5:00 rush hour, crowding the already over-loaded cable cars and making it more difficult for people who have been working all day to get home.

Keep the California cable car.

Would like San Francisco to keep all cable car lines. Reliability of operation could be improved.

Considering all drawbacks, the cable car is still the most agreeable transportation means within the city.

TAXI

I commute daily on a private commuter bus from Marin County - there is only one bus a.m. and p.m. - it stops 2 blocks from my house and 3 blocks from the office - we pay $36/month for a guaranteed seat on an air conditioned modern bus. I used to ride Greyhound but it was horrible - longer walk - bad equipment - no guaranteed seat. I used to hate the Greyhound commute. Now I enjoy it. I look forward to a chance to read in the a.m. and sleep in the p.m. It's also pleasant to be able to socialize with people you know and enjoy a beer on the way home. This commuter bus is so popular people wait months to get on it. In looking for a new lot to build on, we want to stay in this area so I can stay on the bus. B

The bus in question is chartered from a private bus company by 40 residents of the area. It is a modern, air-conditioned coach. It circles the area in the morning picking up passengers at approximately 5 stops. Then it goes non-stop downtown, discharging people at approximately 4 places. At night the procedure is reversed.

The use of jitneys on Mission Street are very convenient.

I take a cab when I have a suitcase or other large articles.

Bus could be reasonable alternative to poor taxi service but traffic is too poor - makes bus too time-consuming - plus bus is far too crowded. B

The bus used is a chartered "commuter" bus.

From my personal experience, I find a jitney the most desirable method of transportation at a relatively low cost.

CYCLE

A safe bicycle parking place in the financial district or in Sausalito would be of great help.

I would like to see more interest in making safe bicycle routes available for close in travel.

I would like to bicycle to work, but because of traffic and lack of route, it is not possible.

If it were safe, I would ride a bicycle to work.

We could use more bicycle parking places to lock a bike to.

In good weather I would ride a bike if I didn't think it would get stolen downtown.

Bicycling is a mode of transportation that I would use if bicycle trails could be established.

WALK

It is important to find a way to decrease the travelling time home-office-home. Thirty minutes maximum walking (one way) distance seems ideal.

Walking, I don't pollute the air or ever endanger the life or well-being of anyone else.

I like to walk.

Presently walk to my place of employment. Commuted for five years to San Francisco; service as a general rule was regular, comfortable and reasonable.

AIR

If long distance trains were very fast, I would be tempted to take them on trips where flight time was about the same. R

Much of travel discomfort is due to trips which require crossing time zones.

We like going anywhere by plane and the cars we rent are always good. A

I firmly believe that San Francisco International Airport is one of the worst in the Nation. The "dual" (old and new) terminals must be extremely confusing to the new visitor. Directional signs are hopelessly inadequate, toll taking for parking is understaffed which results in frustrating delays, and "new" construction in the general area seems to be an on-going thing, without measurable betterment. I think that Oakland Airport will play an increasingly important role in Bay Area air travel. If more airlines came into Oakland, I would urge any friends, business associates, etc., to utilize the Oakland facility rather than San Francisco. It would be almost "criminal negligence" not to link BART to the Oakland Airport. I feel very strongly in favor of now planning a BART-Oakland airport system. BT

The above comments relate to my commute to work. I make several trips from Larkspur to the S.F. airport each year by car. This is a very unsatisfactory means. It's expensive and inconvenient. The public transportation on this route is grossly inadequate. It takes at least 2 hours by bus, and the helicopter service usually A
doesn't make reasonably timed connections at the airport. H

GENERAL

Public transportation does not have to be inconvenient and must be made more attractive to the public. Private transportation should not be used for normal commute trips.

Within reason, would be greatly influenced by proximity of embark-debark points to residence - more than 1/2 miles seems excessive. Number of fares to be paid should be minimized by regional coordination of systems.

Minimum route time of all alternates (bus) currently used. Financial penalty (and environment loss) in rent premium $60/mo. to minimize commute.

When commutes of an hour or more are necessary, they should be comfortable, convenient, and the trip time usable at least for efficient reading.

I cannot ride in autos, buses, trains, or boats where smoking is permitted in all areas.

Interior illumination of public vehicles.

Present public transportation offers no service to the commuter. Operations appear to be scheduled for the convenience of the drivers with the public be dammed attitude.

Rapid transit would be used if available.

No public transportation (for commuting) from Pleasanton-Livermore area to Hayward and beyond.

There are large seasonal changes in time required for commuting. Suggest a recheck of time after people return from vacation.

Transportation very poor.

I think the respondent error rate on this survey will be very high because the layout of the questionnaire is too sophisticated for the average person to digest.

Flexibility of schedule and route time.

Every effort should be made to encourage people to use public transportation and to improve its facilities and services.

Has anyone considered lighter than air type of transportation?

Peninsula public transportation is poor. From Burlingame to Mountain View it is necessary to transfer in San Mateo and again in Redwood City, via Greyhound. Transportation, via public conveyance, from San Francisco to San Jose is inadequate and archaic.

GENERAL (continued)

Inconveniences are usually a function of the unusual aspects of travel - not the normal! Examples: strikes, bad weather and accidents.

Need of rapid transit.

No public transportation available for commuting to work.

Convenient, regular (frequent) transportation to SFO from residential communities greatly inadequate.

Who is to pay for travel? Employer or self.

Live close to work, so have no transportation problem there. Would like to see one unified mass transportation system throughout Bay Area (BART) to use without having to use several modes to conveniently get from one place to another. Sunday car traffic in some areas is abominable! BT A

I would gladly take any transit system to work each day if there was one available. Whatever cost, it would be less than the overall cost and expense of travelling by auto. A

Trip schedule, method, and system carefully planned to avoid problems of all kinds.

Preferred location for family living governs point of origin.

The following are important to my selection of travel modes: (1) safety (rail vs. car-fwy.), (2) cost and (3) time. A R

I prefer the low cost and low pollutional effects of a rapid transit system.

This information is based on EXPRESS COMMUTER DIRECT travel only (EXPRESS is EXCELLENT SERVICE. BART cannot give this good service)! However, on service to areas outside downtown district, it is not as convenient. The schedules for SUNDAY and HOLIDAY are inconvenient and waiting time for transfers. People without cars are dependent on buses for Saturday shopping, Church on Sunday and Holiday travel as well. NIGHT transportation is no longer possible. My friends and I no longer feel safe to go out after 5:30 p.m. Waiting places are dark, unprotected, waiting periods long, etc. We use taxi service for nights and many times for Saturday and Sunday. CHANGING ROUTES of buses. When one has purchased a home with bus service in mind, only to have it CHANGED or TAKEN off that street or area, makes it very difficult. This has happened in East Bay Area and also in Walnut Creek area. B BT T

Factors important to my selection of travel modes are overall time, home to office, total cost; convenience at departure time and congestion.

GENERAL (continued)

I hope this will clear up any doubt you may have had. If it isn't too much trouble, you should publish the results of this survey so the participants can see it. I know I would be very interested to see how it turns out.

Prefer rapid transit travel - cheaper than buses and quicker.

Time of travel between points, and flexibility in schedule.

Being a non-smoker, I find it extremely irritating to have other passengers smoke pipes, cigarettes and cigars in the confines of the vehicle.

Marin-Sonoma need rapid transit badly.

Rapid transit will be good. I think that a reasonable ferry system from Berkeley to S.F. should be set up. F

I don't really think this survey will be too helpful as it doesn't seem to be set up too well. Good luck anyway.

Finish the Embarcadero Freeway. Reduce the city's smog by one-half by getting the commute cars and buses out of the city in half the time. Raise speed limit on "out" toll plaza to accommodate the A
increased flow of traffic. B

Our present concept of vehicles and roads cannot survive. We must change both. Brigham Young was the only man during the past 135 years with the leadership and foresight to see these problems and do something about it. Study him and perhaps, all will learn and resolve.

I detest commute trips of more than 20-30 minutes, but employ the most economical method, in terms of both time and money, that is available.

Slow downtown traffic is big hang up.

Cost is most important factor. $1 per day roundtrip would be desirable.

It is important that the conveying vehicle does not smell bad (due to the uncleanliness of either the vehicle or other persons on it).

The principal reason for choosing my place of residence was because of the convenient travel mode to work.

In arriving at the commute I have explained above, I have lived in 7 locations in five years. I have rated the overall trip at poor, which I consider the best a family man can get in the Bay Area, and this even requires living in the worst climate available. I hope BART will make it possible to move to East Bay, or a fast ferry from San Rafael will make it possible to move to Marin. If neither works, I'm sure we will be leaving the Bay Area within the next five years.

GENERAL (continued)

Availability of local transportation facilities in home area to connect with transportation system into city.

From my location on the Peninsula, Millbrae, there are two forms of public transport that I could use. I have used both in excess of six months each, and have found them to be unsafe, filthy, uncomfortable, with limited daily runs, and schedules unheard of. In addition, they are approximately twice as expensive as owning, insuring, operating, and properly maintaining a second car for commuting by myself. A public transport system that corrected at least two of these conditions would get my patronage.

If I could possibly move out of this miserable, filthy and congested city, I would do so at my earliest opportunity even if it meant walking over an hour to and from work each day. At least my family to be may never have to grow up seeing anything other than cement everywhere and trash filling up the streets. Its strange but people who live here are proud to live in filth, for others that have lived elsewhere - like both my wife and I - are proud only to be passing through. If my job were not here, a move would be in order very, very soon. If a job transfer comes with my company, I'll go fast to escape the mess that is in San Francisco. I've never ever lived any where where the quality and makeup of life is so ill regarded - and then a gay fellow or drunk or prostitute is run over on Market - by some Pacific Hts. type in his Mercedes and then who - I again implore, who cares?

Remove hazardous vehicles and drivers from highways and streets.

I would prefer public transportation if the service in S.F. were more reliable and comfortable.

One way streets for fast traffic; underpasses across large streets; more stop signs; more police to control speeders.

Probably the only practical solution is to move the large employers out of the city.

I would like to see Rapid Transit extended into the San Mateo County and later into Santa Clara County. San Mateo County should have joined BART.

The most important single factor is the pleasantness or beauty surrounding each mode and the transfer points associated with it. Pollsters are chronically shy about asking aesthetic questions; apparently it is considered unscientific. Also, more precise time-cost-comfort-pleasure questions could have been asked about alternative modes of transportation in order to determine their relative competitiveness. Questions 34 and 35 are crude substitutes for the more concrete information that could have been obtained. Those questions assume only one other alternative to the modes actually used. Many persons, including myself, have at least two other comparable alternatives (without resorting to the helicopter or a

GENERAL (continued)

bicycle); the car and Greyhound. From the answers you receive to 34 and 35, you will not know whether the respondent had the car or the Greyhound in mind. If the ferry is closed down, will its patrons take the bus or their cars? As between the ferry and the Greyhound, which is most likely to persuade the most people to leave their cars at home? That is, which mode of mass transit is most competitive with the car? I don't think you will be able to answer persuasively those questions from the results of this questionnaire.

The cost of transportation has been figured in relation to my salary not as to the cost to the population as a whole.

I suggest it is stupid that the Golden Gate Bridge Authority was allowed to continue its existence. They should turn the bridge over to the Highway Department. They are only afraid of the big bad world. The public is being cheated.

UNCLASSIFIED

Degree of traffic congestion is very high at two points (1) Pleasanton to Hayward (4 lanes only) and (2) Oakland to Bay Bridge.

This method of commuting is most enjoyable because it is almost completely free of the tension and competition found in most other methods.

Possibility exists for overseas business trip requirements or business beyond normal hours at all times.

Only alternatives are Greyhound/drive neither of which is desirable due to Bayshore traffic - especially in wet weather.

A quicker and convenient way of travel to the Peninsula (San Mateo, South Area).

More frequent trips should be made available.

Do not commute; take approximately one or two long trips each year.

Yes, business hours are 8 to 5. If given 1/2 hour, would make quite a difference in commute time.

My answer to the above question: are based on reasonable good traffic conditions, and favorable weather conditions. If weather and traffic conditions are not good, travel time may take up to 1/2 hour longer.

Please note that my answers relate to morning and afternoon travel to and from work. After that at night and on Saturdays and Sundays service is infrequent and too often poor.

Lack of police protection; + lack of cost; + lack of hassle, + lack of view; + lack of warmth.

No improvement seen in the future.

APPENDIX D

MATHEMATICAL BASIS FOR RIDGE REGRESSION

Consider a standard model for multiple linear regression

$$Y = X\beta + \varepsilon \tag{1}$$

where X is an observed matrix of (n x p) on p causative variables, β is a (p x 1) vector of unknown coefficients, and assume $E(\varepsilon) = 0$ and $E(\varepsilon\varepsilon') = \sigma^2 I_n$. Also for mathematical simplicity assume that X is standardized in the sense that $E(X_i) = 0$, $\sigma^2(X_i) = 1$ for all i. Then the ordinary least square estimates of β that are unbiased and with minimum variance are given by

$$\hat{\beta} = (X'X)^{-1} X'Y \tag{2}$$

Let $$L^2 \equiv (\hat{\beta} - \beta)' \; (\hat{\beta} - \beta) \tag{3}$$

denote the squared distance of least square estimates $\hat{\beta}$ from the true parameter β. The expected value of this distance can be expressed in terms of the X's so that inferences about the magnitude of L can be made when the X's are interdependent.

$$E(L^2) = \sigma^2 \text{ Trace } (X' X)^{-1} \tag{4}$$

or equivalently

$$E(\hat{\beta}' \beta) = \beta' \beta + \sigma^2 \text{ Trace } (X' X)^{-1} \tag{5}$$

If the eigenvalues of (X'X) are denoted by

$$\lambda_{max} = \lambda_1 \geq \lambda_2 \geq \ldots \geq \lambda_p = \lambda_{min} > 0 \tag{6}$$

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where $Y_1(k)$ is shown to be the sum of the variances of the parameter estimates $\hat{\beta}^*$ and $Y_2(k)$ is the square of the bias introduced when $\hat{\beta}^*$ is used instead of $\hat{\beta}$. It is further shown that (in Hoerl and Kennard) there always exists a $k > 0$ such that

$$E[L^2(k)] < E[L^2(0)] = \sigma^2 \sum_{i=1}^{p} \left(\frac{1}{\lambda_i}\right) \tag{13}$$